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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES EQUIPMENT AND SUPPLIES ASSOCIATION.

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Forthcoming Events.

JANUARY 13.

Sheffield Metallurgical Association:—Ordinary meeting. "Salving Battleships at Scapa Flow," Paper by E. F. Cox.

Institute of Metals (North-East Coast Local Section):—Ordinary meeting. "Copper-Silicon Alloys," Paper by W. B. Goudielock.

JANUARY 26.

Royal Society of Arts:—Cantor Lecture on "Some Modern Developments in Microscopy," by L. C. Martin, D.Sc.

Institute of British Foundrymen.

JANUARY 9.

Middlesbrough Branch:—Ordinary meeting. "The Manufacture and Properties of Malleable Castings," Paper by J. K. Smithson.

JANUARY 10.

Lancashire Branch:—Annual dinner at the Grand Hotel, Manchester.

Wales and Monmouth Branch:—Ordinary meeting at Cardiff. "An Indian State Railway Foundry," Paper by C. A. Howe.

JANUARY 15.

London Branch:—Ordinary meeting. "Cupola Malleable Cast Iron," Paper by H. H. Shepherd.

JANUARY 16.

Sheffield and District Branch:—Ordinary meeting. "The Vitreous Enamelling of Cast Iron," Paper by J. H. D. Bradshaw.

A Practical Man's Job.

Mr. F. P. Wilson, President of the Institute of British Foundrymen, has referred in appreciative terms to an editorial we recently printed on the subject of costing. From conversations with some leading members of the industry it has been brought home to us that a misunderstanding has arisen therefrom. It appears that some managers and foremen imagine that all quotations and costing would be transferred to the "office." This, of course, is nonsensical. What the system does involve is the procuring of a statement from the chief foundry executive of all details germane to the creation of a proper price for quotation. Thus such bases as moulding, core-making and fettling times; experimental and waster costs, weight with runners and risers, tackle, should, and must, be matters for the practical men to decide. The duty of the costing office is to see that such incidentals as sprigs, sand ingredients and mixing, lighting, heating and the hundred and one other factors are taken care of before quoting, and when the job is completed the preparation of a balance-sheet—if the order is big enough—to ascertain the loss or profit.

Any attempt at costing without consultation with the practical will lead to disaster. For instance, one foundry, which has never been prosperous, never consulted the foreman—the "office" merely attached the number of hours allowed to each order received, and expected the schedule thus created to be adhered to. Actually, the foreman added up all the hours, allowed and redistributed them on the best basis he could.

Costing requires tackling more from the auditing end, that is the provision of a system which will enable the owner or directorate to ascertain which orders are lucrative and which are money losers; and the foreman or manager to learn where his strength and weaknesses lie, that is, where better tackle and methods are needed, and if their cost is warranted. Above all, the object of a costing system is to help the practical man with that essential part of his duty—the production of indisputably correct prices for quotation purposes. The "wangling" of hours allowed for one job on to others can in the end only lead to managerial chaos.

Empire Standards.

This country is peculiarly interested in the propagation abroad of our standards of quality and performance for industrial products. Our export trade is world-wide, and we have a system of weights and measures which, while it is the despair of schoolmasters, has a great deal to recommend it on the score of practical convenience. On the other hand, the system used by our rivals, the metric system, is a single system used by all our Continental competitors. On paper it has a tremendous lot to recommend it, and some of the advantages are very real. Hence we should do all we can to spread our standards.

These reflections are called to mind by the recent report issued by the Government on Imperial Standards. It is to our highest interest that standards used in this country should be equally used throughout the Empire. Standards are a definite link in Imperial trade. That section of the report on fundamental standards of length and weight does not call for further comment here, but the section on industrial standardisation is of great importance.

It is shown that there are already in existence associations somewhat similar in character to the British Engineering Standards Association in Canada and in Australia. In New Zealand the local committee of the B.E.S.A. is being superseded by a National Engineering and Industrial Standards Committee, which will work in close touch with the B.E.S.A., and in India the B.E.S.A. is represented by the Institute of Engineers of that country. These bodies have the support of their respective Governments.

The report recommends close working between these bodies and that each body should have a trade mark or brand mark for goods complying with standard specifications.

The process of simplification, *i.e.*, of minimising variations in type and design which do not correspond with a definite need on the part of the consumer, is recommended to the attention of users, distributors and manufacturers.

British standards, by their number and variety, do not make such a spectacular show as those of some countries where the multiplication of specifications proceeds ahead of the demands of the trade, but they have the virtue of being set up only when really needed and then they are used by those concerned. This policy is right, and the development of it throughout the Empire is to be very cordially welcomed.

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

Furnace Goggles.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—Our attention has been drawn to your article on the subject of "Infrex" glass in your issue of December 25, 1930. We are much obliged to you for this. There is one point we would like to deal with. You ask goggle manufacturers to give attention to the provision of glasses of greater density. We are quite sure that we are able to offer glasses of any required density.

Perhaps our previous letter was not sufficiently clear. "Infrex" glass is not suggested for the actual melters, but for those who work round about the furnace and whose eyes are subjected to a lesser degree of heat. For those whose duties require them to look into the furnace we recommend a very dark shade of a special glass we manufacture. We thought we would take the opportunity to write to you in order to thank you for your courtesy, and in case we should have misled you as to the purposes for which "Infrex" glass is recommended.—Yours, etc.,

J. & R. FLEMING, LIMITED.

146, Clerkenwell Road, London, E.C.1.
January 3, 1931.

The Small Fry.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—The leading article in your issue of the 1st instant is of particular interest at the present time.

We hear a lot of talk about "the small fry," "inefficiency," and so on, and it would be well if some of your contributors would give us their views as to just what is meant, and a clear statement as to whether, in their judgment, the *size* of a works is the only measure of its efficiency.

Going back a number of years, I can recall the closing down of a number of steel foundries, not because they were "small fry," nor yet because of over-capacity, but due to reasons which need not be touched upon here.

It cannot be said that many of the firms which have ceased production or have been reorganised were "small fry" or semi-derelict, and the reasons for the trouble must be accounted for in some other way.

So far as competition is concerned, I make the definite statement that some of the larger firms are the biggest sinners in price-cutting, and this applies particularly in the case of those operating a foundry as a subsidiary part of their business. Many of the "small fry" have sound (if not elaborate) cost systems, and it is, obviously, easier for them to keep track of their overheads than is the case with large concerns.

Instead of so much complaining, would it not be better for all concerned to make the best of the demand as it exists, and to co-operate with the object of obtaining a just and reasonable price for what they produce? It is entirely our own fault that we are the "Cinderellas" and are forced to go about in rags.—Yours, etc.,

"NICKEL."

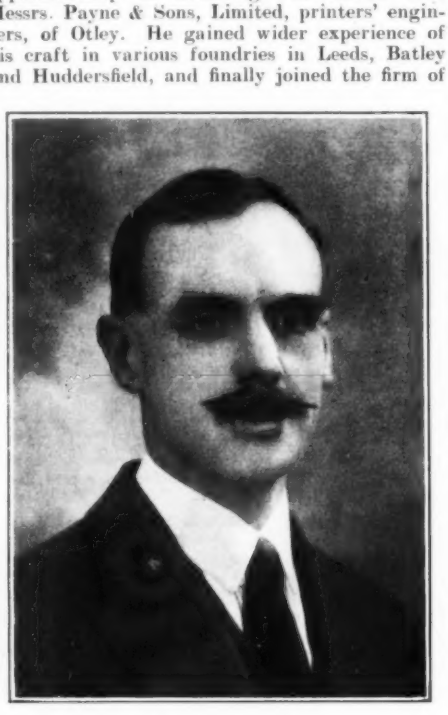
[We have found it necessary slightly to amend this letter, as the listing of firms, especially those which have been reorganised, might create an erroneous and even dangerous impression.—EDITOR.]

Journal Bearings.—A good lining for journal bearings may be obtained from the following mixing:—Lead, 82 per cent.; tin, 1 per cent.; and antimony, 17 per cent. A little copper may be introduced if thought beneficial.

I.B.F. Branch-Presidents.

No. 6.—WEST RIDING OF YORKSHIRE BRANCH.

Mr. H. Sayers is a native of Bradford, and his apprenticeship to moulding was served with Messrs. Payne & Sons, Limited, printers' engineers, of Otley. He gained wider experience of his craft in various foundries in Leeds, Batley and Huddersfield, and finally joined the firm of



MR. H. SAYERS.

Messrs. Hill Bros., of Hunslet, Leeds, who have specialised for over half a century in locomotive and other cylinders. Mr. Sayers passed through all the departments of this firm, and is now foundry manager. He joined the Institute of British Foundrymen in 1922.

A Flux for Magnesium.

By W. E. WARNER.

The properties necessary in a flux for magnesium are a low melting point, low density and good covering power. A flux possessing these properties consists of the following:—Calcium fluoride, 40 grammes; sodium fluoride, 60 grammes; potassium chloride, 11.5 ounces; and magnesium chloride (anhydrous), 2 lbs. These salts should be well mixed together, melted and ingotted before use.

The mixture is hygroscopic and therefore should be protected from moisture. The flux is fluid, has a good covering power and will permit the insertion of a thermocouple for temperature measurements. When melting a charge of magnesium, it is heated until melting commences and then flux is scattered on the surface in sufficient quantity to form an unbroken covering over the molten charge. Heating is then continued.

When completely molten the melt is stirred, then allowed to stand for a time, removed from the furnace and poured, the dross being held back by a skimmer. Cast-iron moulds should be employed, which are dressed by spraying with French chalk. A polished black-lead surface is also satisfactory. In order to prevent the formation of oxide during pouring, an atmosphere of CO_2 should be maintained in the crucible during melting, the mould should be filled with this gas before pouring and a stream also directed on the falling molten metal. This will to a great extent prevent oxidation.

Random Shots.

The latest craze, midget golf, has died suddenly after a very short life. The evolution of competitions and various other devices, including price reductions, did not save it. As I passed the Engineers' Club building a few days ago, I found the erstwhile temple of midget golf again closed. I think I predicted this some weeks ago in this column. The game wasn't hard enough, and I doubt whether it called on real skill. Chance probably plays a great part in success.

* * *

Another reason for the exhaustion of public interest is doubtless the mass production of courses, making holes too much alike and the same in different courses. The canvas base commonly used left a lot to be desired. The obstacles were not changed often enough. The free courses run by the big stores and the Underground probably did the other establishments a lot of harm. There appears to be just as much room for individual design in a midget course as in an ordinary golf course.

* * *

Here is a little story that will raise a laugh the next time you have to make an after-dinner speech. A certain tradesman, a profiteer, had amassed money more quickly than he could acquire the society manners of the people his wife and daughter wished to move amongst. One day his grown-up daughter complained to her mother that his finger-nails were perpetually dirty, and asked if something couldn't be done about it. "I know," replied that lady. "I make him go to the manicurist three times a week, but it's no use, because as soon as he has his nails clean he will scratch his head."

* * *

I have suffered too much at the hands of after-dinner speakers to desire ever to inflict similar suffering on anybody else. So I invariably decline such invitations as come my way. This very English way of spending an evening badly needs reforming. It isn't really a sociable function because you do not get a chance of speaking to anybody except your immediate neighbours, unless the dinner is not punctually served. However, punctuality is not a vice from which diners-out suffer.

* * *

Speech in these days of cheap newspapers, telegraphic communication and radio broadcasting has not the importance that it had when it was a main means of communication between people.

* * *

A few suggestions for the improvement of public dinners are as follow. They are not patented. To begin with, the meal should be short (*i.e.*, it is not necessary in these days to offer entrée as well as joint or joint and game with fish on the menu, and the English abomination of having both soup and hors-d'œuvres should be abolished). It should be served expeditiously with a view to getting it over in, say, not more than 90 minutes, including speeches. Toasts should be cut down to "The King" and one main toast of the evening, which, if necessary, should include toasting the body concerned and all its branches and all the visitors or guests in one comprehensive gesture. The temptation to bring in other speakers either to propose or to reply should be resisted. Then real social intercourse, or cards, or dancing, or light entertainment should follow. Smoking between courses and entertaining between courses should be abolished. You see what a little dyspepsia can do!

MARKSMAN.

Magnesium-Alloy Castings.

A joint meeting of the London Branch of the Institute of British Foundrymen and the London Local Section of the Institute of Metals—which during the last few years has become an annual event—was held in the rooms of the Chemical Society at Burlington House, Piccadilly, London, W.1, on Thursday, December 11, 1930. Mr. A. F. Gibbs (President of the London Branch of the Institute of British Foundrymen) was in the chair.

A Paper on "Magnesium-Alloy Castings" was read by MR. E. PLAYER (of Coventry), the main points of which were covered in our issue of December 27, 1928.

Vote of Thanks.

MR. W. T. GRIFFITHS (Chairman of the London Local Section of the Institute of Metals), proposing a vote of thanks to Mr. Player for his Paper, said that those who had had at some time or other to deal with magnesium in the form of wire, flashlight powder and so on must be inclined to wonder at first how on earth anybody could do anything with the metal in the foundry. In addition, when he had heard in Mr. Player's early remarks some of the further unthought-of difficulties met with in practice, his thoughts on looking at the beautiful examples of castings exhibited by Mr. Player had been somewhat similar to those of the old country lady who, on seeing a giraffe at the Zoo, had said "There ain't no such animal." Mr. Player, however, had shown how the castings could be produced, and his explanations of the manner in which the almost unique difficulties pertaining to magnesium had been overcome were most interesting.

Mr. Griffiths also took the opportunity to express the pleasure which members of the London Local Section of the Institute of Metals derived from their annual joint meeting with the foundrymen. The meeting was amongst the most enjoyable attended by members of the Section, and the standard achieved on previous occasions was being maintained that evening. He was sure that all the visitors would like him to express their gratitude for the hospitality shown them and for the opportunity given of hearing Mr. Player's masterly exposition.

MR. G. C. PIERCE (Past-President of the London Branch), seconding the vote of thanks, said that a good deal of money had been spent on experiments in connection with the production of magnesium and magnesium-alloy castings, and as a result some very wonderful castings were being produced. For a long time he had been very interested in this subject, and on one occasion, when he had been given an opportunity to make a magnesium casting, he had enthusiastically accepted it. His experience on that occasion was such that he could refute with confidence a libel which was very often levelled at foundrymen—that they could not move themselves when in the foundry. In consequence of this experience, he warned foundrymen not to use magnesium unless they knew very definitely what they were going to do. Magnesium castings which were being produced lately, however, had astounded him, not only from the point of view of their strength, but also their machining qualities—and such qualities were not always possessed by other light-alloy castings. At the same time, there was yet before us a very great development in connection with magnesium and its alloys.

The CHAIRMAN reciprocated the feelings expressed in the latter part of Mr. Griffiths' remarks, and assured him that the members of the London Branch of the Institute of British Foundrymen welcomed heartily their colleagues in the Institute of Metals.

The vote of thanks to Mr. Player was carried with acclamation.

MR. PLAYER briefly responded.

DISCUSSION.

DR. O. F. HUDSON (British Non-Ferrous Metals Research Association) acknowledged the good service which Mr. Player had rendered in bringing to the notice of the meeting the great advances which had been made in the casting of magnesium alloys, and added that the wonderful results obtained were due to the very ingenious methods adopted in the melting and casting. It was extremely interesting to note the resistance afforded by this very reactive metal to most of the corrosive influences, and, as Mr. Player had said, this resistance was due to the formation of a protective film. In connection with this question of resistance to corrosion, and the selection of alloying metals, Mr. Player had referred to the differences in the electro potential. It was true that that question was of importance, but perhaps the most important factor in that connection was whether the alloying metal was held in solution or whether it occurred either as a compound or in the free state disseminated through the metal. Dr. Hudson believed that in many cases the differences in the positions on the electro-chemical scale were not so important so long as the two metals concerned were in complete solution.

A Practical Strength Test.

MR. WESLEY LAMBERT (Past-President of the Institute), commenting upon the light weight of magnesium-alloy castings, recalled that when in Germany two years ago he had visited a showroom containing a very large collection of typical castings of "Elektron." There was one particularly large casting, and he had been astonished to see a workman lift it single-handed, without mechanical aid, from a bench, dust it, and replace it. He had also been a very interested witness of a test applied to some tyre rims for one of the German makes of automobiles. These rims were about 20 in. in diameter and of quite thin section. A rim was placed upright on a concrete floor, and a man hammered it with a 7-lb. sledge hammer; about 30 full blows had to be delivered before fracture occurred. The test demonstrated that "Elektron" is a very tough and strong alloy. He had seen both the extrusion and forging of magnesium alloys, and no difficulty seemed to be experienced in working the metal. On another occasion he had seen a forged aeroplane propeller and a number of forged pistons also of magnesium alloy. He believed "Elektron" to be an alloy with a very great future. The consequent low inertia due to the comparative lightness of the magnesium alloys was very attractive to the engineer. He (Mr. Lambert) understood, however, that, although a number of automobile manufacturers had used magnesium pistons in the past, nowadays such pistons were being used to a lesser extent than formerly. The reason, he gathered, was that the use of magnesium or magnesium-alloy pistons necessitated the redesigning of automobile engines to suit the magnesium-alloy pistons. He asked Mr. Player if this was a true statement.

Sulphur Fumes.

MR. FREEMAN HORN (British Aluminium Company), as a representative of the aluminium industry, contradicted the belief which appeared to be held by some people that to refer to magnesium in the presence of a representative of that industry was equivalent to holding a red rag before a bull. Indeed, he said that the aluminium industry regarded magnesium rather as an ally than an enemy—and it was significant that all the useful alloys of magnesium contained aluminium; the magnesium founders could not get on without aluminium. In the same way, the highest tensile-strength aluminium alloys—the forged alloys—contained magnesium. Those facts constituted a good augury for the future. Another significant fact was that, whereas aluminium was attacked by alkalies and not by acids, the contrary was the case with magnesium. There was every reason to believe, therefore, that in the future the two metals would be developed side by side. At the same time, he directed some criticisms against magnesium, one of them concerning the difficulty of handling it in the foundry. Whilst he agreed that extraordinary progress had been made in recent years, it was yet rather early to talk about the production of magnesium castings in the ordinary foundry. He did not know exactly what was the output of "curative" fumes, but it would be interesting to know what the Ministry of Health would say if all the foundries in Coventry were to use magnesium instead of aluminium. Would the Ministry advise people to go to Coventry in order to be cured of their ailments, or would they forbid it? Again, magnesium founding entailed high labour costs. At present one could not ask any but the most highly-skilled workers to produce castings in magnesium, and, furthermore, the workers engaged must be highly conscientious, because, unless everything was done as it should be, the results were disastrous.

Nomenclature of Light Alloys.

Discussing nomenclature—for he was always anxious to apply appropriate names to the various products—he said that the original "Elektron" produced by the Greischem Elektron Company in Germany was an alloy containing 50 per cent. magnesium and 50 per cent. aluminium, but the present-day "Elektron" contained about 90 per cent. magnesium and 10 per cent. aluminium, though there were slight variations in the proportions of these two constituents. That alloy, containing 90 per cent. magnesium and 10 per cent. aluminium, had been known previously as "Magnalum." He did not know whether or not that was a proprietary or registered name, but it seemed to be a very excellent name. In the same way, an alloy containing about 10 per cent. silicon in aluminium was usually known as "Silumin." He asked if Mr. Player could say why "Elektron" had not been given a more descriptive name.

Commenting on an illustration shown by Mr. Player of an aircraft wheel with a brake drum cast on, he recalled that recently he had seen in a German journal a description of a wheel, made in "Elektron," in which the whole surface of the wheel was used as the braking surface. That development had resulted from the fact that the added weight of a brake drum on an aircraft wheel was a serious consideration. By casting the whole wheel in light alloy and using the whole surface as a braking surface, very excellent braking was effected, and the costs of production were reduced in comparison with the cost of producing a wheel with the ordinary brake drum.

Die-Cast Alloys.

With regard to Mr. Player's reference to the difficulty that in gravity die casting—he preferred to call it "chill casting"—the metal had to stand for a longer time than was necessary in other processes, with the result that trouble due to oxidation arose, he said he had gathered that that trouble had been overcome to a large extent. It had been stated by Mr. Player that that trouble was not experienced in connection with pressure casting, but one would have expected considerably more trouble in that case, when air pressure was used.

It was interesting to note that in this country there was in use an alloy containing 6 per cent. aluminium, 3 per cent. zinc and about 0.5 per cent. manganese. Apparently the zinc was not used in America, and there the alloy contained from 6 to 8 per cent. of aluminium and from 0.2 to 0.4 per cent. of manganese. He asked what advantage was gained by the addition of

zinc, because the figures he had seen indicated that the properties of the straight aluminium-manganese alloy were better than those of an aluminium-zinc-manganese alloy.

Nickel-Magnesium Alloys.

MR. H. J. MAYBREY, B.A., expressed the view that the nickel-magnesium alloys were worthy of some sort of development. He personally had experimented with them and had secured very useful tensile strengths and very good resistance to atmospheric corrosion. He asked if Mr. Player could give further information on that subject.

DR. H. J. GOUGH referred to the importance of mass inertia in many engineering components, and said one would have thought that one of the most useful applications of magnesium alloys would have been found in the pistons for high-speed internal-combustion engines. He inquired if the use of magnesium alloys for such pistons had been discontinued because of their lack of resistance to stresses at fairly high temperatures. The majority of castings of the type illustrated by Mr. Player were not designed so much from the point of view of their ability to withstand stresses, but to secure sufficient stiffness. The stiffness of a particular metal depended on its modulus of elasticity. Speaking from memory, he said he believed the figure for steel was about 30 millions, and for aluminium it was about 10 millions, whilst the figure for magnesium was about 6 millions. He would have thought that in replacing any particular casting in which stiffness was the chief factor one would have to use a much bigger scantling in magnesium in order to get the same stiffness, and therefore the figures quoted by Mr. Player—in which a saving in weight achieved by changing over from some other metal to magnesium corresponded exactly to the specific gravities of these metals—appeared to be too good to be true. He hoped Mr. Player would enlighten the meeting further on this important aspect of engineering design.

Soundness in Magnesium Alloys.

MR. H. SUTTON said that the low modulus of elasticity of magnesium and magnesium alloys was of practical importance and for many purposes a disadvantage. As one who had had opportunities of examining magnesium castings after the somewhat critical operation of finish-machining, he said that Mr. Player had not over-rated the soundness of those products. Most people who had had experience of light-alloy castings were able at some time to form conclusions as to the tendencies of the various alloys towards porosity and pin-holing, and his impression was that in magnesium-alloy castings a higher standard had been set than had yet been achieved on the commercial foundry floor with aluminium-alloy castings. Of course the conditions varied from casting to casting. With regard to corrosion, the point which had impressed him most was the very great change which had taken place in the magnesium and magnesium alloys themselves, and he believed that that was attributable to the great advances which had been made by Mr. Player and others in the industry who had devoted themselves so assiduously to the production of sound, clean metal.

Chromate Immersion.

Years ago, if a piece of magnesium-alloy casting or forging were placed on the window-sill of an ordinary room for some months, it would have been found to be covered by a hoary white deposit. He was glad that substantially such experiences belonged to the past, and, apart altogether from the application of protective treatment, the modern material had considerable resistance to ordinary atmospheric influences. His experience of chromate-immersion treatments and others of that type was that they did produce very useful protective coatings against corrosion under normal conditions, particularly when supplemented by a suitable enamel.

Fire Risk Non-Existent.

With regard to the question of fire risk, Mr. Sutton said he had seen deliberate attempts made to cause the ignition of parts made in magnesium alloy in an internal-combustion engine. He had seen gallons of petrol burned with this end in view, and the worst that could be done was to cause, by assiduous overheating of the whole thing, rapid melting of the magnesium and ultimate collapse. It had been possible, he admitted, to see traces of flame, but that had not occurred until the structure had substantially collapsed. In this connection he recalled an interesting demonstration he had seen some years ago of the lack of fire risk in the machine shop. He was visiting works abroad, and was approaching a machine at which a man was working and smoking a cigar. At his side there was a considerable heap of magnesium-alloy turnings. The machinist had dropped his cigar, which had fallen on to the heap of turnings, and, although he (Mr. Sutton) and other visitors were considerably alarmed, nothing had happened. The machinist had picked up his cigar and relighted it. The match he had used was thrown on to the heap of turnings and remained there burning. The alarm of the visitors was even greater than before, but the only result of the dropping of the match was a slight fizzling and some flame. Without turning from his work, the machinist had kicked on to the heap some more turnings which had not ignited, and by this means had extinguished the flame. Mr. Sutton said he judged that this incident was not entirely unrehearsed.

Origin of Pin-holing.

MR. S. L. ARCHBUTT agreed that it was remarkable that the cast magnesium alloys should be so free from pin-holing. It seemed fairly definitely settled now that pin-holing in castings was due to absorbed gas, which was evolved and entangled during solidification of the metal. It might be that magnesium as now produced was very free from gas, and in rather better condition in that respect possibly than aluminium, owing to the different conditions of manufacture. When magnesium alloys were melted, they were carefully protected from furnace gases by means of a flux, and no doubt that helped also, whereas aluminium alloys were melted without a flux covering, and the methods employed for melting aluminium were very largely such that they did not help to prevent the absorption of gases. An improvement in that connection might be looked for in the future, in the light of knowledge obtained in regard to methods of melting. He asked Mr. Player if the magnesium castings, which were so extraordinarily sound, were all sand cast. It was the sand-cast aluminium alloys particularly which suffered from pin-holing.

Treatment of "Y" Alloy.

Commenting on Mr. Player's statement that the heat-treatment of "Y" alloy was expensive and for that reason it was at a disadvantage as compared with cast magnesium alloys, Mr. Archbutt said that magnesium-alloy castings had become very much cheaper, but he was wondering whether they were yet so cheap that they could compete directly with heat-treated aluminium-alloy castings. He suggested, also, that probably in the future Mr. Player would wish to heat-treat magnesium-alloy castings; some of them were quite capable of being improved by heat-treatment. Regarding the statement that "Y" alloy was difficult to cast in sand he would point out that most new alloys presented difficulties until one found out the proper methods of handling them, and then the difficulties disappeared. He was interested in Mr. Maybrey's reference to the use of nickel in magnesium. Undoubtedly there would be a much larger field available to magnesium alloys if they could be strengthened; research was in progress at the National Physical Laboratory with a view to producing better magnesium alloys. Alloying with nickel did appear to offer some possibilities in that direction. Research was in progress to discover metals which would form solid solutions with magnesium and so produce a stronger matrix on which to found better alloys in the future.

The progress that had been made in the production of magnesium and magnesium-alloy castings had been remarkable and reflected great credit upon all concerned. He believed that magnesium-alloy sand castings were produced now almost as readily as aluminium-alloy sand castings.

Sand Conditions for Magnesium-Alloy Castings.

MR. H. W. G. HIGNETT, referring to the preparation of the sand for the magnesium and magnesium-alloy castings, said he had had the opportunity to compare the results obtained with the sand slinger with those obtained when using the jolting machine, and had found that, for the same castings, in order to secure complete freedom from scabbing under limiting conditions of bond, a fatter sand was required for the slinger than for the jolter. He asked Mr. Player for information as to whether any special precautions were necessary when using the sand slinger, and also for information as to the milling of the sand and the methods used to ensure perfect mixing of the sulphur-boric-acid mixture.

Relative Weight and Design.

MR. R. B. DEELEY, commenting upon the enormous reductions referred to by Mr. Player as having been made in the weights of castings as the result of replacing other materials with Elektron, drew attention to the fact that in several cases mentioned the reduction was more than could be accounted for by the difference in specific gravities. In one case a casting weighing 76 lbs. in malleable iron weighed 13 lbs. in Elektron compared with over 15 lbs. which would be anticipated from the specific-gravity ratio. He presumed that Mr. Player had redesigned the casting and cut down thickness, and, if that were so, he (Mr. Deeley) would be glad if Mr. Player would indicate what precautions were taken in view of the low modulus of elasticity mentioned by Dr. Gough.

With regard to nomenclature and Mr. Horn's reference to "Silumin," Mr. Deeley said that the modification of aluminium-silicon alloys was first patented in America by Dr. Aladar Pacz, who adopted the name "Alpax" which is used for these alloys throughout the world, with the exception of Central Europe, where the word "Silumin" is used.

AUTHOR'S REPLY.

MR. PLAYER, replying to Dr. Hudson's references to protection against corrosion, said that the relative immunity of the present-day magnesium alloys, as compared with the older ones, from corrosion was due not only to the intelligent selection of the alloying metals in regard to their electro-potential differences, but also to the relative freedom of the metal, as cast, from non-metallic impurities—this relative freedom being due to the fluxing treatment. He was not in a position to speak authoritatively as to the possibilities of increasing resistance to corrosion by producing alloys in which the whole of the constituents, or the majority of them, were in solid solution in the matrix, but he agreed that the nearer we could get to that ideal, the better. He believed that one physical reason why magnesium had a greater resistance to ordinary atmospheric corrosion than might be expected from an examination of its chemical characteristics was that, when cast in the ordinary ingot, it was definitely free from pin-holing—the old bugbear of the aluminium founder. Mr. Player added that he personally had to make aluminium as well as magnesium castings, so that he was quite impartial in his outlook towards the two metals. It could readily be

conceived, he said, that in any material the surface of which was a series of plains and craters, *i.e.*, whose surface was pin-holed, the penetration of corrosive reagents under the skin would be facilitated. If an aluminium casting—certainly if made in L5 alloy—had been exposed to the weather for two or three months, or for only a few weeks if the weather were wet, little "fungi" would grow in local spots all over it, and it was quite conceivable that these "fungoid" growths, which were, of course, the hydrate or hydrated oxide, had arisen from the craters or pin-holes. That feature was almost entirely, if not entirely, absent from the magnesium alloys. The symptom of corrosion in magnesium alloys under ordinary atmospheric conditions—and he had carefully watched specimens, including some thin ones, over long periods—was the acquisition of a uniform dirty-grey colour; unless a little flux had been occluded through careless casting, rarely would local growth be found. That probably contributed to the relative freedom of magnesium from corrosion, in spite of the high chemical activity of the metal.

Pistons.

Replying to Mr. Lambert, he said quite frankly that magnesium pistons were not used largely in internal-combustion engines because they were not hard enough for that purpose. So far as he knew, there had not yet been developed any magnesium alloy which had a sufficiently high Brinell hardness numeral at the normal working temperatures of pistons in the internal-combustion engine. For engines working at lower temperatures and lower speeds than those installed normally in English vehicles fairly satisfactory results could be obtained with magnesium pistons over a fair period of time, but to the best of his knowledge and belief there was not yet developed a magnesium alloy which would give that long and good service that was expected in such an important component as the piston in high-speed, high-compression, high-temperature engines.

Dealing with Mr. Horn's remarks, he expressed the hope that no one at the meeting had gathered the impression that he had advertised magnesium to the detriment of any other metal. Nothing was more antagonistic to his temperament than that, but it was very difficult to read a Paper on magnesium alloys without saying something about magnesium. It was perfectly true that the production of magnesium castings had not yet been developed to the stage at which it could be undertaken in any ordinary foundry. The special technique he had described in the Paper placed the process quite outside the scope of anyone who was not prepared to study the work very carefully and to be very patient in training and equipping the staff; furthermore, magnesium casting must be done in a building confined to that material only. If an aluminium founder set off part of his foundry for magnesium work, and managed to get the magnesium well mixed up with the aluminium alloys, he would have enough interest to keep him out of mischief for months. He did not think that the health authorities would raise any objections if all the foundries in Coventry concentrated their attention upon magnesium. One could stand outside the door of the magnesium-alloy foundry without being aware that sulphur was being used inside. If one walked through the foundry at about 4 p.m., however, on a still day, when casting had been proceeding for hours, and when there was no air moving, the vapours would cause watering at the eyes. Use and habit cured most things, however, and although at first the men employed were inclined to cough and weep, when they became accustomed to it they were not affected. Presumably the tissues of the throat, nose and eyes became inured to it. The employment of high-grade workmen was necessary in practically every form of production, in any material, where a high-class article was required.

In the early days of the aluminium industry there were no ready-made aluminium moulders; iron moulders had had to be trained to mould aluminium, and an iron moulder in an aluminium foundry was a very expensive luxury during the first three, four or five months. The men were good iron moulders, but they had to learn how to handle aluminium. Similarly, men had to be trained to work in the magnesium foundry. If one had the right type of good average craftsmen, who were willing to learn, and if one were patient enough and could stand the racket financially, those men would in time be able to produce magnesium castings at about the same labour cost and in about the same time as an aluminium casting. There was no ready-made nucleus or school of experienced magnesium moulders; they must be taught, and their teaching cost money, but when they were taught they were just about as good as the balance.

Nomenclature.

Dealing with Mr. Horn's comments concerning the name "Elektron," he asked: "What's in a name?" The name "Magnalum," like "Elektron," was a generic term, applied to a fairly wide range of alloys—ranging from 30 to about 90 per cent. aluminium, the remainder in each case being magnesium. The name "Elektron" was really a trade mark, applied because the firm which had developed it in Germany originally on a large scale was the Greischem Elektron Company.

Aircraft-Wheel Brakes.

He agreed that the necessity for providing brakes for aircraft wheels had given rise to very serious problems for the manufacturers to solve, in view of the importance of reducing weight to the minimum. He understood that it had been made compulsory to fit brakes to the wheels of all Service aircraft and to all machines plying for public hire, and certain firms had been much troubled until they had realised the possibility of using magnesium alloys. The wheels had come to be cast complete with drum to take the brake lining as well. He had not seen the type of wheel in which the whole surface was utilised as the braking surface. Normally the brake drum formed a recess in one of the side flanges of the wheel itself, and, owing to the light weight of the magnesium alloys, it could be made almost as large in diameter as the rim itself so as to provide a large frictional area.

Die Castings.

The answer to the question as to why there was no trouble in regard to oxidation in pressure die castings, although trouble had been experienced with the ordinary gravity die castings, was that all pressure castings in aluminium or magnesium were more or less unsound, whatever one did with them. There were physical reasons for that. They were fairly well impregnated with blowholes, and, owing to the impossibility of putting feeders on a pressure casting, the outside skin was very tight and would chill quite tough. The thicker the casting, the more open the core. Pressure castings were seldom used for highly-stressed parts, and one did not trouble very much about the oxide and nitride. The crucible was protected by flux only in the initial melt, after which a little sulphur was thrown on from time to time. Gravity die castings, however, which were applied more to highly-stressed parts, must be thoroughly sound, and oxides or nitrides, or anything of that sort, could not be permitted inside the metal; hence the necessity for fluxing.

Replying to Mr. Maybrey, he said that a certain amount of work was being done with alloys containing nickel, but he was not aware of the results obtained.

Designing Allowances.

The moduli of elasticity quoted by Dr. Gough for steel, aluminium and magnesium were correct, and were recognised in design; therefore, it was advisable to stiffen a magnesium-alloy casting which was to be subjected to high stresses. If changing from aluminium to magnesium it was better to have the sections a little thicker and secure the required rigidity, and be satisfied with a saving of weight to the extent of 30 per cent., than to do without stiffening and save 40 per cent.

As to the rate of production, he could only speak for the firm with which he was connected, and they were producing approximately from 40 to 45 tons of magnesium-alloy castings per month.

The remarks made by Mr. Sutton with regard to the modulus were very sound, but Mr. Player considered that the soundness of a casting was as important as the modulus. It was not of much use having a casting with a high modulus of elasticity if the material were of such a nature that, if the casting were complicated, it would contain a number of porous places and cracks which were not visible.

With regard to fire risks, he said it was impossible, under conditions normally obtaining, to fire magnesium except when it was in a very finely divided form and had also free access to the air.

Pin-holing.

As to the problem of pin-holes, his theory was that in the aluminium alloys there were occluded or dissolved gases which were separated again on cooling. In the case of magnesium, however, most of the gases so dissolved—such as oxygen, nitrogen and carbon dioxide—would form solid compounds, which were nitrides and oxides, and these were removed by the fluxing process. They could not exist in the gaseous form in the magnesium. Hydrogen could and did exist in the gaseous form, and only under certain rather unusual conditions—such as when the metal had been damp and had become dry only just before it had become molten—would hydrogen be formed, and then it did not form pin-holes, but definite blowholes.

Commenting on Mr. Archbutt's references to "Y" alloy, he pointed out that a heat-treated alloy would always cost more than an as-cast alloy, all other conditions being equal.

Replying to Mr. Hignett, he said that the facing sand was milled ordinarily. With regard to the mixing, it was not necessary to achieve the maximum homogeneity. The sulphur vaporised, and it had only to be locally distributed; as soon as the metal came into contact with the sand the gas itself permeated everywhere. The sand slinger and jolt rammer gave much the same results—both were unsatisfactory unless they were handled rightly.

Finally, dealing with Mr. Deeley's reference to the relative weights of the tramway gear casings made in malleable iron and magnesium alloy respectively, he said the figures he had given were the actual weights; he added, amid laughter, that the dimensions of the "Elektron" castings were somewhere near the drawing dimensions.

New Blast Furnaces for Tata.

It is reported that the Tata Iron & Steel Company, of Jamshedpur, will shortly begin the erection of two new blast furnaces capable of producing 1,600 tons daily to replace three which are being dismantled. Escher, Weiss & Company, of Zurich, are furnishing most of the material, with German and American collaboration. The product is to be foundry iron for export. The pig-iron, which is selling extensively in Great Britain at the moment, is fetching about 35s. per ton at the furnaces.

Flux for Aluminium.—Salt is a reliable and cheap flux for aluminium. It will also serve quite well as a flux for copper when the latter is used for making brass castings.

Electrical Repairs in the Foundry.

By "Kilowatt."

Although the engineer of a modern foundry may fully appreciate the application of electric power in connection with the operation of the plant, he does not always realise that the advantages so obtained are equally available in the repair shop.

Portable Electric Tools.

It has for a considerable time been the recognised practice to utilise fixed machine tools for all work in the repair shop that can be conveniently transported and fixed on the bed of a machine. When, owing to the size of the material to be machined, the work has to be carried out by means of a hand tool, two alternatives are open. Either the work can be performed slowly and laboriously by a simple hand tool, the power being supplied by manual labour, or portable tools can be employed. There is quite a wide range of portable electric tools available, including the electric drill, hammer, saw, grinder and screwdriver, each appliance being a real labour-saver over the older methods of carrying out repair work.

Power is supplied to these tools through a flexible cable attached to the nearest convenient wall-plug or lamp-holder, a switch being mounted close to the holding-handle of the tool so that the motor, which forms part of the tool, can be started or stopped at will. A quick-break switch is usually fitted, making and breaking the circuit suddenly, thus cutting out arcing troubles at the contacts. One of the most robust and convenient types is the trigger switch. Forced ventilation for the motor is obtained by means of a small fan mounted on the armature shaft.

The electric drill is made in several types and sizes, varying in capacity from $\frac{1}{8}$ in. to $\frac{1}{4}$ in., weighing from 4 to 5 lbs. A tool of this kind, comprising a $\frac{1}{8}$-in.-h.p. motor, weighs about 6 lbs., and can be held and operated by one hand. The motor usually runs at 2,500 to 3,000 r.p.m., and drives the spindle through a reduction gear at drilling speeds suitable for the class of work to be done.

Another useful machine in the workshop is the electric grinding machine. This is either single- or double-ended, with wet or dry grinding wheels. The power consumption of a machine of this type amounts to only one unit of electricity per hour.

There is also the portable electric saw, weighing from 12 lbs. to 15 lbs. In operation the worker merely holds the saw in his hand, and keeps the rotating blade to the line along which the wood is to be cut, a flat plate resting on the face of the work while the saw is in operation. A quick make-and-break trigger switch is located in the handle, so that the operator has the tool entirely under his control. A rather ingenious application of this saw is to be found when cutting hardwood flooring which is in need of repair. This particular job, when using an ordinary tenon-saw assisted in the chisel, is a difficult and in many cases a lengthy one. This saw can be carried about or taken into any part of the factory in the same way as an ordinary hand-saw.

The electric hammer, shearing machine and screwdriver are all to-day made as portable electric tools, and the latest addition to the already long list on the market is a general utility tool. This, it is claimed, can be used as a portable electric drill, for decarbonising motor engines, as a sensitive bench drill, as a bench tool for grinding, polishing and buffing, and as a saw.

Soldering is another familiar job in the workshop, and here again electrically-heated soldering irons may be used with advantage, cutting out the old laborious task of heating the irons in a coal or coke fire to the accompaniment of much smoke and fumes. Moreover, the electric method is safer, more rapid, and certainly more efficient.

Electric Welding.

One of the many important applications of electric heat, that has made rapid progress during the past ten years, is its use in connection with welding. In the process commonly employed to-day an arc struck between the work as one pole and an electrode wire as the other is employed as a fusing medium. The heat generated causes local fusion both of the work and the electrode, so that metal can be supplied to make a union in the molten state. The temperature of the weld must necessarily exceed the melting point of the metal, which is commonly in the neighbourhood of 1,370 to 1,595 deg. C., but since an excessive temperature causes overheating, the margin is kept as low as possible in the best work. The rate of fusion depends, of course, on the current passing across the arc, and it increases with it to a value of perhaps 20 grains of deposited metal per minute at a current strength of 120 to 130 amperes. Beyond this, current losses become excessive and working unsatisfactory. The necessary supply voltage varies to some extent with the class of work, but a pressure of 35 to 40 volts is usually sufficient, and with direct current any considerably greater supply voltage will generally involve a good deal of waste power. One relatively cheap type of electrode has a thin coating of a more or less volatile material to steady the arc, and, by means of the gases evolved, to screen the metal from oxidation. Another type depends for its efficiency on the composition of the electrode metal itself. Developments in the direction of producing a metal which shall inhibit nitride formation and render the oxides innocuous are likely to have a considerable influence on the future of welding. At the present time use is frequently made of protective mineral slags, which are supplied in the form of a comparatively thick sheath over the electrode wire, and form a coating over the molten metal during the process of deposition, thus preventing its direct contact with the atmosphere.

Being commonly acid in character they help to clean the work, and it is also claimed that they enable a certain amount of annealing to take place. One objection, however, is that these slags do not eliminate nitrogen from the weld, and that unless skilfully applied the nitrogen may be introduced inside and weaken the weld itself.

Welding may be applied in engineering practice in two ways, namely, as a constructional process and as a method of repair. For certain constructional processes, of course, special methods of welding are employed, such as butt welding and flash welding; these have, however, limited application, and arc welding is generally much more useful. The possibility of employing welded instead of riveted joints has been affecting mechanical design to an increasing extent for some years, and the adoption of welded construction to replace castings is at the present time receiving considerable attention from progressive mechanical and electrical engineers.

Special castings, such as bedplates, involve expensive patterns, which may never be used again, and these can be entirely eliminated, together with anything up to 50 per cent. of the weight of metal, by the use of a welded construction. There must be few designers at the present time who could not find some profitable use for electric welding, particularly as the plant involved is not unduly expensive. A certain amount of prejudice remains, it is true, against the uncertainty of the strength in a weld, but when the process can be successfully applied, and survive rigorous tests in ship and boiler construction, there is not much room for serious doubt. Neglect to adopt the method is in many cases due to want of familiarity with its potentialities.

The main advantages of substituting welding for riveting in all welded steelwork erection are briefly as follow:—

There is a considerable saving in material in that many members of a structure may be reduced in section owing to the elimination of rivet holes, and the possibility of designing them on more economical lines. For instance, tubular section may be substituted in place of built-up stanchions, etc. In many cases cover plates, angles and gussets can be reduced or eliminated. Floor beams may be of lighter section as continuity of action is obtained through the column attachments due to the rigidity of the welded connections. There is also an appreciable saving in time and labour. This first appears in the drawing office, where the natural simplicity of designing welded structure is at once apparent, and also owing to the absence of complicated joints, details and rivet pitching, etc., with their attendant dimensioning, the working drawings themselves are simplified and the number reduced. In the works, templating is reduced to a minimum.

One of the main savings in cost and labour is due to the fact that in many cases the bulk of the material can be delivered direct to the site of erection, requiring no attention in the shops. During erection a welder replaces a squad of riveters, while corrections and alterations can be carried out with a minimum of time and trouble.

Dr. Werner Resigns.

Dr. Ing. S. G. Werner, after about 20 years' occupancy of the chair of the German Iron-foundry Employers' Federaton, has resigned. The Doctor's charming personality and gift of leadership combined to make the Verein Deutsche Eisengiesserein, giesserei Verband the most powerful foundry organisation in Europe. When the time arrived for international co-operation in foundry technical matters, Dr. Werner's personal interest was such that he was unanimously elected its second President, following Mr. Paul Ropsy. The esteem in which Dr. Werner is held in German foundry circles is to be perpetuated for all time by the annual award of the Werner medal, the highest honour a foundryman can receive in that country. We offer, on behalf of the British foundry industry, hearty congratulations on the great success which has attended his efforts and sincere good wishes for health and happiness in his well-earned retirement.

Publication Received.

Mechanical World Year Book, 1931. Published by Messrs. Emmott & Company, Limited, 65, King Street, Manchester. Price 1s. 6d. net.

In the preface an acknowledgment is made of the suggestions received in the past indicating where improvements were possible. Thus we are glad to see that our advice to eliminate the expression semi-steel has been acted upon, and now steel mixture is used in its place. It is a very handy book for executives to keep by them when called upon to carry out some work a little removed from routine.

A coolant for cutting magnesium or magnesium alloys is paraffin oil or a 4 per cent. hydrous sodium fluoride.

X-Ray Examination of Castings.

AN AID TO DESIGN.

A meeting of the Sheffield Section of the Institute of British Foundrymen was held at the Mappin Hall, St. George's Square, Sheffield, on Wednesday, December 17, 1930, when Dr. V. E. Pullin, O.B.E., Director of Radiological Research, Research Department, Woolwich, gave an address on "X-ray Examination of Castings."

The BRANCH-PRESIDENT (the Hon. J. M. W. NORTH), who was in the chair, said that they had deviated a little from their usual practice in order to have a special lecture. A lecture on X-rays by such a recognised expert as was Dr. Pullin was obviously of great interest to the iron and steel and other industries.

DR. PULLIN said that he was in a little difficulty when he was first asked to lecture to them as to what particular aspect of the subject to choose. After some consideration, he decided that the best thing to do was to present to them the practical application of X-rays to engineering matters generally, leaving out all more theoretical considerations. Generally, X-rays might be applied to engineering in two ways. One either used them to look at the defects in the material—lack of homogeneity of structure—by what was called radiography, that is, by taking pictures using X-ray as a lamp; or they might use the radiation to study the fine structure of the materials. They might use it to determine how the atoms which made up the structure were arranged with reference one to another. He thought that if that branch of the subject, known generally as X-ray spectrum-analysis, was developed, it would be found to have the greatest possible value in engineering, providing they kept clear, from the practical point of view, of the vast field of purely theoretical work involved in the subject.

Practical Applications of Spectrum-Analysis.

Spectrum-analysis dealt with crystalline materials and, fortunately, from the engineering point of view, all metals were crystalline, by which was meant that they were built up by a perfectly regular arrangement of small units, perfectly regular and perfectly symmetrical. When such units were arranged in a perfectly symmetrical way in three dimensions—up, down and across—forming a mass, such an arrangement was known as the crystalline condition. Now, when formed, those little units each in turn formed the crystalline state, which also had a perfectly regular formation. For example, in iron the atoms were arranged in a perfectly definite order. These little units, which they called structural units, were so arranged that they had one atom at each corner and one in the middle of the system. This meant that those atoms repeated themselves in their formation of lattice work and ultimately formed a crystal. Other materials were also crystalline, but they had not, perhaps, the same structure. Some metals had an atom at each corner and one in the centre of each face. This was called the face-centred cubic crystal. A curious thing about iron was that, in one such condition, but when they raised its temperature very high, the atoms shook themselves up, rearranged themselves and adopted another formation. They adopted the face-centred cubic formation. One of the important differences was that in this lattice formation the atoms packed themselves as close as they possibly could to one another, whereas in another formation they packed themselves rather more loosely. The body-centred crystals and those that were face centred would reflect the X-rays differently. They would get differently-reflected beams having a different angle of reflection.

In this connection the lecturer gave the equation as:—

$$\eta \lambda = 2 a \sin \theta$$

That was the equation, he said, on which was based all X-ray spectrum-analysis. It meant that the wave length of the X-ray might be equated to twice the distance separating the atom layers times the sine of the angle of incidence of the rays. It was that simple equation that underlies all the analyses he was going to explain.

Application to Welding.

Slides were then shown of experiments made by the lecturer. Illustrations of the spectra of alpha-iron and gamma-iron were displayed. Another illustration showed a form of spectrometer that was used by the lecturer in his work. The lecturer demonstrated, by means of the slides, how to obtain perfectly symmetrical reflection by the X-ray apparatus. He showed the method might be applied with great advantage to welds. He said that when they had orientation in a metal it was due to preferential arrangement of the crystals. If they annealed the metal they shook up the crystals by the application of the heat causing them to lose their preferential orientation.

In summing up the details he had given with the assistance of the slides, Dr. Pullin remarked that, although he had referred to the investigation of lattice distortion in metals and alloys, he did not think that he would be right in assigning at present to that technique a really practical significance. Experimental details and arrangements were much too difficult. The measuring of lattice distortion was not, he thought, a work particularly suitable for the factory or works. It required a very high degree of academic skill.

Radiography.

Turning to the consideration of radiography, the lecturer said it was a curious thing that when they had a new development in science they produced in the minds of the laity interested two general attitudes—one of incredulity—in fact, of hostile scepticism, or else one of undue optimism. The application of X-rays was a new science, but it was sufficiently old to have emerged from the first of these conditions and was now launched on both feet. However, a little while ago he was asked by a very eminent engineer about the application of X-rays to the examination of certain structures. The engineer said to him: "I would like to give it a chance. I will bring my structure out here and you can bring your tripod and take a picture of it." Such a remark was perfectly amazing in these enlightened days. An X-ray apparatus was not a kodak, and, although it was not a difficult technique, it certainly could not be manipulated by the mere pressing of a button. What they did was to use an X-ray lamp that had the curious property of being able to penetrate and show up differences in density without breaking the material down. That was why radiography was valuable. In the course of taking a radiograph certain phenomena happened of which they had to take cognisance if it was to produce a good radiograph. If they interposed anything between the X-ray tube and the plate they interposed a fog bank. The effect was the production of a general diffusion. The only X-ray beam which was of value in forming an image, or shadowgraph, was the direct beam which came from the X-ray lamp, passed through the specimen, and suffered in its passage certain differential absorption and so produced a variation in blackening in the emulsion underneath. Then there was the question of scattered variation to be considered. When they passed the X-ray beam through any material, two or three things happened. In the first place, the material acted as a fog and diffused the radiation. That scattered radiation acted on the plate and reduced contrast. Another thing was that when they radiated an object by means of X-rays they caused the object itself to become a source of X-rays. Theoretically it might be shown that the thicker the specimen of metal they wanted to penetrate, the higher voltage must they use. The higher voltage they used to generate the X-rays the more they increased the penetrating power. It could be shown theoretically that as they increased the voltage, and thereby produced more penetrating X-rays they also produced very much more scattered radiation and consequent fog, so much so that it would appear, by one theory at any rate, that when they arrived at radiation generated to about 230,000 volts, the scatter in a thick piece of steel would be so great that they would not get any image at all. If that was the case, it was clearly of very little use developing the subject to penetrate very thick pieces of steel. However, he was always a little sceptical of theories based on the behaviour of atoms, because they altered so frequently.

X-Rays not for Routine Inspection.

Here the lecturer exhibited a film of a practical experiment he made to test that theory. He said that he took a piece of steel and generated it with 150,000 volts. Then he increased the thickness and could still get a picture. He increased it further, and could not get a picture, but upon further increasing the voltage, he could. Further pictures were shown of the effects of scatter.

After a number of further slides were shown and explained, Dr. Pullin concluded his remarks by some general observations on the subject. The place for X-rays, he said, was clearly not inspection. It was much too expensive to apply generally. It was, however, useful in inspection where they were dealing with high-grade castings where soundness was important and where the work was of the highest possible grade. The main use for radiography was in the foundry. It seemed to him that, when a new casting was designed, then was the time to examine it. They would then be able to see the types and location of flaws, and could alter the technique or design very quickly and usefully. X-ray was not a routine inspection method at the present time, so much as a consultation method. If it was properly used and properly installed, it was a consultation method and was of the greatest value.

DISCUSSION.

The CHAIRMAN (the Hon. J. M. W. North) said that, as far as the practical application of X-rays was concerned, they were now rather in an optimistic stage, but there was no doubt whatever that in time to come, and very soon, he thought, they would be using X-rays for the examination of castings, particularly where, in mass-production work, the design of one casting meant so much with so many of the same kind to be made. He shared Dr. Pullin's view that the chief application at present in regard to X-rays should be from the designer's point of view, and not from an inspection point of view. They all knew they had sometimes to make some very awkward castings—castings which seemed to the moulder to be unnecessarily complicated—which were very often due to the designing staff having no foundry experience. One thing that could be done was to exhibit those pictures they had seen that evening, or pictures like them, in a drawing office, so that they could be seen by the designers of castings. They could not break up every casting that had a flaw in it and take it to the drawing office, but by means of the pictures, works' executives could see how important it was that the castings required

should be designed from the point of view of ease of manufacture in the foundry. In the spectrum-analysis they perceived a very useful method for determining stress in castings. As they all knew, it was very difficult to find out how a casting was stressed or, sometimes, whether it was stressed at all. It was easy enough to do so after it was broken up, but by that time they might find that there was no stress, and the casting was wasted. By means of the spectrogram, stresses could be discovered. Dr. Pullin had showed them some effects of heat-treatment. Recently they had had a lecture in Sheffield on heat-treatment, and it would have been interesting to know what results Dr. Pullin could have obtained in regard to the castings that were heat-treated. It would have been interesting to have had a spectrum-analysis taken of those castings.

Area of Plate.

Replying to a question regarding a statement he had made in the lecture that usually the area covered by the X-ray plate was a square foot, DR. PULLIN said that a larger area could be taken, but the usual practice was to consider an area of a square foot. It depended upon what they were looking for. The most practical area, all things considered, from the point of view of exposure and detail, was about a square foot.

Answering another question, DR. PULLIN said that ordinarily X-rays took no account of chemical components. On the other hand, X-rays might be used in the most interesting way as a method of chemical analysis, but that was a different matter altogether. Recently there was considerable difficulty in regard to the cracking of certain steels alleged to be due to the absorption of tin solder. Such a case came to him for an expert opinion. He applied the technique of X-ray chemical analysis and found undisputed evidence of tin in a fracture. That, however, was another branch of the subject which had quite an interesting application but was rather complicated.

A MEMBER asked Dr. Pullin to give his definition of a blow-hole, saying he was not inclined to agree that what were referred to on the screen by the lecturer as such were in fact blow-holes.

DR. PULLIN replied that he might have used the term somewhat loosely. They were, perhaps, contraction cavities as apart from contraction cracks. If they had, on the one hand, a structure with a true blow-hole in it, and another structure having a series of contraction cavities, they could not tell the difference by an X-ray picture.

Asterism and Orientation.

Answering another question, DR. PULLIN said that, although he would not be too emphatic about the matter, there was evidence that when they had got stress in a metal structure, it produced, not orientation such as he had described, but a curious thin, spoke-like appearance known as asterism. When they relieved that stress by breaking it they got orientation. It would appear that they got that asterism as the stress increased; when they broke it they got the orientation. Therefore one was inclined to say —although with great diffidence—that the asterism was characteristic of stress and that orientation characterised the relief of stress. What he had shown them that night were only those things that he was certain about. He had shown them examples where that particular form of spectrum-analysis had been used in regard to heat-treatment. He had said that it was a most sensitive detector of heat-treatment; that was all. When they rolled or hammered a metal they caused the crystals to orient themselves.

Degree of Penetration.

MR. J. ROXBURGH asked Dr. Pullin if he would indicate the degree of penetration of the X-rays. He had particularly in mind some thick castings that had to be made from time to time which had to withstand hydraulic pressure. After all the machining had been done they might fail on the test.

DR. PULLIN replied that under practical conditions the maximum penetration was 3 in. In the laboratory, under ideal conditions, the rays could penetrate 5 in. From the practical point of view he would not advise X-ray examination for more than 3 in. of steel at present.

Answering the chairman, DR. PULLIN said he hoped that eventually it would be possible to determine strain in castings by spectrograms. They were able to determine the chemical analysis of material now with a varying degree of accuracy according to circumstances.

Portable Equipment.

MR. C. D. POLLARD inquired whether portable X-ray apparatus was available in the foundries for castings of heavy bulk or whether it was necessary to take such castings to the laboratory.

DR. PULLIN said that at the present time he was constructing a high-power equipment to work 250,000 volts for use as a travelling laboratory. It would be taken about on a trolley and could be fixed up anywhere. One of his assistants would go round with it. At present it was only intended for Government use in dockyards and various Government inspection establishments. He hoped that it would be ready in the New Year, and he hoped to go round and demonstrate it. He might be able to bring it to Sheffield.

Thirty Years' Progress.

PROF. FEARNSIDES (Sheffield University) said that from 1900-02 he was helping Messrs. Heycock and Neville in the taking of their X-ray photographs of gold-aluminium alloys and certain other metals to the thickness of 1 millimetre. The process enabled them to find all sorts of things about the constitution of crystalline alloys, but they found they were up against the limitation that in all cases they were dealing with shadow-graphs. They now heard that in 30 years the advance that had been made had only been sufficient to penetrate metals to 3-in. or 5-in. thickness. There was much pessimism in the old days about the commercial usefulness of X-rays for the determination of metallic structures, and he had always expressed that it would cost so much money that they would probably ascertain as much about castings by breaking one up. They were glad to know of the progress that had been made. They knew that a great deal of money and thought had gone to the investigation of the possibilities of the process.

DR. PULLIN said he was very interested in hearing about the early experiments with X-rays. He had in his possession an X-ray picture of a fractured arm that his father took in January, 1896. The exposure was 45 minutes, and the picture was a very poor one. He himself took a similar picture two or three years ago in less than a thousandth of a second, and it was a much better picture than the other one. He thought that progress had been rapid. He remembered that in 1918, with the best apparatus available in the country, they could only get through half an inch of a shell.

Dr. Pullin was heartily thanked for his lecture, and the CHAIRMAN expressed the hope that he would bring his travelling apparatus to Sheffield for a demonstration.

New Tank for National Physical Laboratory.—A new tank is to be provided for test work in ship propulsion at the National Physical Laboratory at Teddington at a cost of £45,000. It is to be 207 ft. long, 20 ft. wide, and 9 ft. deep. The new tank has become necessary owing to the rapidly increasing demand for test work for the merchant navy.

A Beautiful Piece of Metal Work.

By H. LITTLEHALES.

Till some few years ago a gentleman, a collector of antiquities, possessed a very remarkable piece of pewter work made by an English craftsman in the middle of the 17th century. Upon the death of the owner this very interesting piece of work became by will the property of the nation, and was sent to the Victoria and Albert Museum. By the courtesy of the Director of that institution we are enabled to include an illustration of this salt, or, as we call it to-day, salt-cellar.

This piece of pewter is large, and though exceedingly plain, is of interest to us as being of English make and of pewter. Pewter articles being soft and of little intrinsic value when old and battered, have in most cases disappeared, though their number both in ecclesiastical and

A 17TH CENTURY PEWTER SALT.

secular establishments through many centuries was enormous.

In form this salt is singularly attractive. Its top consists of a broad, bold, octagonal, flat surface set on a short, fat, plain stem, which in its turn rises from an octagonal, broad base. Four bands of exceedingly delicate and pretty ornament encircle the whole, which is in every respect one of very great interest and beauty. As a piece of simple design and craftsmanship this salt is very possibly without a peer. It is well worthy of careful study by any metal worker, whether of the foundry, fitting shop, bench or drawing office, it being as near perfection as metal work well can be which depends on graceful and beautiful lines and delicate and unobtrusive ornament alone.

Briquetting Metal Scrap.—The development of a briquetting machine for cast-iron borings and steel chips has increased the value of that scrap metal almost threefold. This is vouched for by its users, including a number of large automobile works and other plants that have hundreds of tons of this material to dispose of annually. Experience has shown that chips and turnings of this sort, when held together loosely, cannot be profitably remelted. But in the form of well-compressed briquettes, such as the machine is capable of producing, the scrap constitutes what might be called selected stock that can be melted with as little loss as is pig-iron. The Buick Motor Company has installed in its Flint, Mich., plant a Southwark briquetting machine having a rated output of 3 tons per hr. This is the largest made so far—ranging from that size on down to a machine of ½ ton capacity. One briquette is made at every cycle of the plunger—the forward stroke forcing the chips from the magazine into the compression chamber under a pressure of 300 tons, and the return stroke stripping the finished product from the chamber—the magazine the while being recharged with chips. Briquettes with a density of as high as 85 per cent. can be turned out; and, although no binder is used, they hold together even when dropped on a hard surface. When used for briquetting steel turnings, the machine is provided with a special hopper that breaks up the pieces so that they can be fed easily into the compression chamber. At the plant in question the scrap value of the metal was formerly $7 a ton. Now it is said to be worth $20 a ton.

Concerning Mr. William Thwates, Ironmonger and Founder, of York.

By H. Littlehales.

On October 12, in the year 1511, when Henry VIII was king, Mr. William Thwates made his Will. He was probably ill at the time, for he died in the next year. Mr. Thwates was a founder and ironmonger in the old city of York, and his Will and inventory may still be seen in the York Registry. The Will we may put aside, but the inventory attached to it is one which may well be of special interest to workers in metal, for it tells us what we would have seen in an ironmonger's shop and foundry four centuries ago.

Mr. Thwates' Will bequeaths his property in the ordinary way, but the inventory evidently deals with the stock-in-trade alone, not a chair, bedstead, blanket, sheet, pillow or any article of the home proper finding any mention in the inventory; even those things mentioned as being in the buttery are such articles as were of metal only. These omissions are of no consequence, for we know from countless other Wills what a flourishing business man would have to leave in the way of domestic and personal property of that date, but we know very much less of the articles he would use in his work. What these articles were in the case of a 16th-century ironmonger and founder this inventory very largely tells us.

The inventory speaks of the things in the "halle," "shoppe," buttery, "parlor," "kitchyn," two rooms over the shop, and the foundry, which latter is called "workhusse." The foundry house was at that time often known by the expressive term of "melting-house." But the inventory omits various articles which would be required by a founder. There are no pincers, burnishers, whetstones, grindstones, shovels, tongs, rammers and several other articles indispensable in a foundry. Nor from the ironmongers' side is the list as comprehensive as one would expect. It is fairly clear that, as in many other cases, some things had first been disposed of.

The foundry proper was probably of much the same character as such places are to-day—namely, a floor of sand, or earth as Mr. Thwates calls it, with a more or less open roof above. It contained, as we know, a furnace and various tools and appliances.

A Tudor Foundry.

The inventory details the typical business premises of an ordinary ironmonger and founder in the days of the Tudors. It indicates that the 16th-century ironmonger was also often a founder and that the things turned out in the foundry were offered for sale in the shop, which was, it is to be noted, adjoining, with a room over it.

The particulars of the inventory have been taken from the copy printed in Vol. 5 of the Surtees Society's Proceedings, published in 1884. No article mentioned in the inventory has been omitted, but the prices appended to each item as a valuation have not been given. The reader has here before him the full list drawn up in the autumn of 1511. It will be noticed that the language is Northern English; this makes the names of several of the articles more difficult to understand. So far as may be, the present writer has added an explanation, but, even with the aid of Murray's great and invaluable dictionary of words in use from the year 1200, a number of the words in the inventory have defied elucidation, at any rate by the present writer. It is to be remarked, however, that North Country commercial travellers in the metal industry are often familiar with words now no longer in general use. There are many founders' Wills in the great registers of Somerset House, but not one is of the interest which that of Mr. Thwates supplies.

Curious Domestic Hardware.

Let us see now what this inventory tells us of the stock-in-trade of Mr. Thwates. In the *chamber over the shop* was £11 8s. 4d. in three separate sums. The money is evidently set down here as having some relation to the business.

In the *hall* were "hallynges," which we may believe to have been some sort of metal pots; an apron, four axes, two swords and two daggers. Also there were two basins of "overse worke" (that is, oversea or foreign work), two lawars (jugs), a "jak" or jacket, a sallet or metal cap, a gorget, two gussets, each of which was probably a number of metal links sewn on to strong cloth or leather, for use as a metal polisher. There were also three gauntlets and a bill.

In the *buttery* were an immense number of pewter spoons, six silver spoons (probably here by an oversight) and 11 lbs. of "layth metell," the meaning of which we are unable to discover.

In the *kitchen* there were many sorts of pots and pans, 4 spits, a roasting iron and a broche.* There were 2 rakes and a pair of cob-irons. The cobirons were the two uprights of iron upon which a spit rested and turned. There was also a brandreth, which was a grating over a fire; a frying pan, 2 pairs of "pot hyngynges," or pothangers; a flesh crook, a slice, a knife, a balk of iron, 4 crocks, a pair of cogges* (unknown to the writer), a skimmer and an iron pestle in a stone mortar. This last is an odd feature, for the 16th-century mortar was generally of brass; here, in a founder's house, it is of stone! There were also a pair of bellows, a water can, a dressing board and a brew ledde, 4 stands, 6 tubs, a kneading trough, a "soo," that is, a sow or pig of lead or iron, a ladle, a "ste" (possibly a staybar), a gallon measure and 2 sieves, which Mr. Thwates spells "cyfvys," but in those days one could spell freely in any way one liked, even to one's own name. As we know, sieves are important articles in a foundry. Though they are mentioned here as being in the kitchen, it is, though possible, very improbable that they were here for any domestic purpose.

The Sales Shop.

In the *shoppe* were 4 censers, almost certainly of brass and of which one was "garnyshed" or decorated, a holy water "fatt" or vat, a chafing dish, 7 basins, 11 candlesticks, 15 little candlesticks, a "tabar dish," 4 sacring bells for church use, 12 ladles and skimmers, the feet of 2 censers (possibly brought in for repairs or to be fitted to new upper structures), 17 candlestick floures turned. This word floures occurs again, but the meaning is not apparent. There were, too, 41 dosen of metal of "wesh and thrawyng," 27 dosen hukshankes (some kind of hook?), 10 files "greate and small," and 2 rowners (?). There were 6 hake hammers, 4 clench hammers, a big hammer and 2 small ones. These hammers were all probably made for the use of masons, for in early days the chisel and mallet were not as frequently used as the small so-called hammer, which was really a little axe or scutch with which the mason cut and shaped stone. Also a pair of clames (possibly vices or clamps), 3 picks, 2 shavyng knives (which we may take to be a form of spokeshave, but possibly were razors), a pair of compasses, 2 "ryne spindles" (?), 2 pairs of shears, 3 lathes and 2 chests. There were also some shelves and "many small instrumentes." It is not easy to understand what these "many small instrumentes" may have been. If they were such delicate tools as trowels, squares, beads or cleaners, used by the moulders, one would have supposed them to have been the property of individual workmen. But quite possibly these particular small tools may have belonged to the master.

Foundry Plant.

In the *foundry house* the weight of metal amounted to "4 cwts. less 6 lbs." It is difficult to say quite how many pounds there would be, for, as to-day, the cwt. was not at all times 112 lbs. There were 31 ware patterns. The pattern is here and throughout the inventory invariably in the form of "patron," as was usual throughout the country at that time. There were, too, 5 great "fete patrons" and 4 floures, 3 dosen small patterns, 5 bells and a pick, rings and staple patterns, 3 iron balks, a quantity of latten (which we to-day call brass), 4 stone of lead weights, 2 crose heds of led, and a "kulyngtune," the meaning of which we cannot fathom. There were also 60 "sane" and 2 "mawrelles," which appear to have some relation to each other, but the meaning of neither have we been able to trace. There were "24 dosen and 4 lbs." of iron gear; 6 dosen of old iron and 24 spindles, of which 4 were of brass. "The molds" might possibly be moulding boxes; they can hardly be the patterns, for, as we have seen, they come under their proper names: founders in Tudor days certainly had earth and stone moulds. To-day the pattern store of a foundry contains hundreds of patterns which have been in use, but, as we have seen, judging by the number mentioned by Mr. Thwates, the 16th-century founder had no very large number at any time. There were 6 dosen "chaufer spyndilles," which, it is clear, were spindles subjected to heating; 23 pots for meltyng, which we may suppose to have been crucibles for use in the brass foundry; a furnace over which were 10 "baukes," a barell of white earth, a lode of earth and a quantity of "mayd earth." The white earth would probably be sand of a light colour; it was quite common in mediæval foundries. The "made earth" was, perhaps, sand already made up and prepared for immediate use in casting. Finally, there was a "tour stole," with all things pertaining, but exactly what was a tower is not at once apparent, but the tower stool was not an uncommon article in mediæval foundries.

It is to be noticed that, though a number of patterns were kept, not a single tool with which we may suppose the pattern to have been made is mentioned. This need not surprise us, for the patternmaker probably in most cases brought his own tools to the workshop. We see them often left by Will in the case of workmen of good standing, and sometimes his "workeday" clothes bequeathed too.

* We suggest that a "broche" was a large-sized skewer, and "cogges"—helve-heads.—EDITOR.

Locomotive Axle Brasses may be made from the following mixing:—Copper, 77 per cent.; tin, 9 per cent.; lead, 14 per cent.; and a trace of phosphorus.

Statistics of the Iron and Steel Industries (1930).—A new edition of "Statistics of the Iron and Steel Industries (1930)" has been published by the National Federation of Iron and Steel Manufacturers. As usual this volume contains comprehensive statistics of the principal iron- and steel-producing countries of the world. Tables also are included, giving the world's production of iron ore, pig-iron and steel from 1866 to 1929. In addition there is a comprehensive tariff section giving the duties applicable to various iron and steel products imported into the various countries. The volume can be obtained from the Offices of the National Federation of Iron and Steel Manufacturers, Caxton House, Westminster, S.W.1. Price 5s. 5d. post free

Strength and Structure of Superimposed Welds.

The use of the arc-welding process for building up material has developed to a considerable extent during recent years. In the majority of cases the parts so reinforced are of high-tensile or wear-resisting steel, and the same qualities are, of course, desired in the deposited material. It takes an appreciable time to measure the resistance to wear by the usual method of grinding away the metal, so that, as a rule, it is judged by the Brinell hardness. The latter is recognised, under normal conditions, as being proportional to both strength and resistance to wear.

With metal deposited by fusion, the Brinell hardness may be satisfactory and apparently indicate the desired strength and wearing properties, but these are not always given in subsequent operation. This applies particularly where, as often arises in works practice, unsuitable automatic welding plants, using low-carbon electrodes, are employed on high-tensile material, wear sometimes taking place five times as fast as on the original surfaces.

The reason for this discrepancy between the results expected from the usual tests and those actually obtained has been investigated by the Research Laboratory of the A.E.G., Berlin. The report of this work was published by MESSRS. O. DAHL and S. SANDELOWSKY in a recent issue of "Stahl und Eisen." They experimented with eight qualities of welding rods, the analyses of which, and of the deposited material, are given in Table I. It will be noted that with rods of low carbon and manganese content, these were almost completely burnt out, but that the percentage loss was much lower with high proportions of these elements.

TABLE I.—*Particulars of 4-mm. dia. Welding Rods.*

Welding rod. No.	Condition of surface.	Chemical composition.					
		Electrode.			Deposit.		
		C.	Si.	Mn.	C.	Si.	Mn.
1	Black, soft	0.06	0.13	0.34	—	Trace	0.10
2	Rusty, soft	0.05	0.08	0.45	—	,,	0.30
3	Polished, spring-hard	0.08	—	0.46	0.01	,,	0.30
4	,, semi-hard	0.11	0.13*	0.70	0.02	0.02	0.50
5	Semi-polished, hard	0.57	0.08	0.44	0.14	Trace	0.30
6	Rusty, semi-hard	1.07	0.20	0.12	0.82	,,	0.04
7	Rough, hard	0.94	0.06†	0.24	0.70	,, ‡	0.08
8	Grey, semi-hard	0.95	0.21	11.75	0.70	0.04	10.2

* With slag coating. † 1·7 per cent. W. ‡ 1·5 per cent. Cr.

Two deposits were made on low-carbon steel with each rod. One consisted of a single layer, while the other had two layers, the second alongside and partly overlapping the first, in accordance with ordinary welding practice. Brinell tests were made on the original material, on that deposited and also at the junction of the two. These showed that with low-carbon rods the maximum hardness was at this junction, but with the high-carbon rods it was highest at the surface of the deposited layer. The effect of the second layer of welding material was to reduce the maximum hardness in both cases.

The subject was further investigated by using welding rod No. 3, containing 0.08 per cent. C, on a 0.4 per cent. nickel-chrome steel of 44½ tons tensile. In spite of the softening effect of the overlapping layer, hardening took place in the superimposed weld, the hardness being greatest at the junction. Sections were cut at various points; the microphotographs of these are given in the original report. These showed that while a certain transfer of carbon took place between the high-tensile material and that welded on, this was quite unimportant, and certainly insufficient to account for the hardening. Ferrite and pearlite were present in various proportions, but there was no trace of sorbite. The structure was exceedingly fine-grained.

This led to the conclusion that the ratio between the tensile strength and Brinell hardness must be entirely different in the case of the deposited metal from that which applies in the case of rolled bars or forgings. For the latter this ratio is 0.34 to 0.36. Test-pieces were therefore prepared from cast electrodes. Some 600 tests have been made, the tensile strength varying from 20 to 50 kg. per sq. mm. (12.70 to 31.75 tons per sq. in.). The results showed considerable variation, but, in the main, gave the ratio of tensile strength to Brinell hardness as 0.25 to 0.30, the value 0.30 being applicable with high-tensile strength. It has been shown that the Brinell hardness measured at the junction of the superimposed weld was due to internal cooling stress.

Heat Losses and Life of Open-Hearth Furnace Arches.*

By ALBERT SCHLÜTER, Dipl. Eng., Bochum.

The absence of numerical data relating to the wear of the arch of an open-hearth furnace and the variation of its heat losses during its life, led the author to carry out experiments on a furnace producing quality steels with a capacity of about 17 tons, the arch being constructed of 230-mm. and 300-mm. bricks.

Between the beginning and end of the period during which measurements were taken, the heat losses were found to increase nearly threefold—from 3.21 to 8.5 per cent. of the total heat consumption of the furnace. The proportion of the arch losses to the heat consumption of the hearth increased from 8.89 to 22.6 per cent., an equivalent quantity of heat having to be supplied to cover the loss. The significance of the arch losses is shown most clearly in comparison with useful heat, as the ratio rose from 0.224 to 0.725. At the end of the life of the arch under examination the heat losses amounted to 0.725 times the useful heat.

Wear of Arch.

The rate of wear in the arch differed at the various measuring points, increasing towards the rear wall and being greatest over the tap-hole. This is (continued the author) in accordance with practical experience, but no explanation is forthcoming as to the irregularity in the rate of wear locally and its constancy in regard to time. The greater wear of the arch towards the rear wall cannot be due to the greater thickness of the bricks (300 mm. as compared with 230 mm.), as the constancy of the wear in respect of time demonstrates that it is independent of the thickness of the bricks. The unequal wear will rather be due probably to differences in temperature, although slight, in the internal surface of the arch, and to inequality in the intensity of attack by lime, slag, etc. The unequal temperatures are due to the leaking-in of air through the flap valves and the more intense radiation of heat from the arch towards them, while conversely radiation is hindered directly over the flame, and the heating is consequently intensified. In working out the data an overall uniform mean internal temperature of 1,500 deg. C. is assumed; this is permissible because the fluctuations in the melting and changing-over periods are not perceptible externally.

* "Stahl und Eisen."

The uniformly constant wear of the arch in respect of time—*i.e.*, the fact that the rate of wear is independent of the thickness of the brick—is due to the principle on which the open-hearth furnace works. It is intended to work at as high temperatures as possible, but these are limited by the quality of the refractory bricks. The temperatures prevalent in the internal surface of the arch are at all times only slightly below those at which the bricks soften and begin to fuse. As compared with the original fusing point of the charge that of the bricks in the furnace is even further lowered by the action of slag sprays, slag and metal vapours, etc. On the surface of the arch a thin liquid film is formed, which gradually runs off on to the sides or else drops down and is constantly replaced by a new film. The rapidity of this process is dependent, among other things, on the nature of the bricks, their composition and porosity, the amount and composition of the slag which reacts on the bricks, and also the temperature.

The depth to which the heat penetrates into the bricks, or the thickness of the softening zone, is proportionate to the thickness of the bricks. The rate at which the liquid film drops off the arch would therefore have to be proportionate to the thickness of the bricks, and in some furnaces this is in fact the case. The results of the tests, however, did not generally confirm this, as the rate of wear did not decline with decreased thickness of the bricks. They showed that the principal factor producing wear is the slagging of the bricks, the degree of which is less dependent on the depth of penetration of the heat than on the quantity and composition of the slag-forming materials on the bricks. The depth to which slagging penetrates and the thickness of the bricks liquefied into a film appear therefore to be but slight on the whole and to be little dependent on the temperature. It is only in this way that the fact can be explained why the wear is not accelerated when the arch is very thick and the temperature gradient in the brick is flat. With very energetic cooling (artificially with compressed air when the arch is very thin), the formation of the film, however, is apparently reduced and the wear is in this case retarded.

From the foregoing it follows that with the usual wear of an arch the principal factor, apart from the refractoriness of the brickwork, is its liability to be attacked by slag and by lime and ore dust. By usual wear we must understand the gradual slagging of the arch as distinguished from wear due to overheating or burning away. In the case of exclusively usual wear, the arch could be made of any thickness desired, as proved by the measurements made.

Every arch, however, is overheated at times, so that the fusing point of the bricks is reached and they begin to flow. In this case the thickness of the arch affects the results of the overheating, and consequently the wear of the brickwork. The thicker the arch the more uniform, of course, is the temperature gradient, and the greater the depth at which the effect of the excessive temperature becomes apparent. It is a well-known fact that when a new arch is started, loose flakes are quickly formed, whereas in old arches only thin wisps generally make their appearance.

The economic thickness of the arch is limited by the bricks' increasing liability to burn off or melt down as the thickness is increased. The less danger there is of burning off, the thicker can the arch generally be made. The danger in this respect is not dependent on the thickness of the brick but on the circulation of the gas and the possibility of its affecting the brick. A thick arch is not more liable to burn off than a thin one, but the consequences are in this case more serious. The life of the open-hearth furnace arch is therefore dependent on the usual wear (slagging) and burning off. Ordinary slagging is affected mainly by the quality of the brick, while burning off can be prevented by a suitable guiding of the flame.

The Heavy Shops of Messrs. Glenfield & Kennedy, Limited.

From Our Engineering Correspondent.

In June, 1929, the new heavy engineering shops at the works of Messrs. Glenfield & Kennedy, Limited, Kilmarnock, were "officially" opened, consisting of three bays, each 240 ft. long and 60 ft. wide, with a height of 64 ft. to the apex of the roof, almost entirely of glass.

As indicated by Fig. 1, these shops are fully occupied, and the firm have had in hand large contracts for some of the most important hydro-electric and irrigation schemes in the world, while in Fig. 1, at the back, is shown part of the condensers for the new Kirkstall Power Station at Leeds, being a fine example of high-grade casting on a large scale.

FIG. 1.—THE HEAVY SHOPS OF MESSRS. GLENFIELD & KENNEDY, LIMITED.

The works at Kilmarnock now occupy 28¾ acres, and fully 1,700 men are employed, while the total site owned by the company on both banks of the River Irvine is 123 acres.

It is well known, of course, that Glenfield & Kennedy, Limited, have long specialised, in fact, since 1865, upon every class of appliance for the control of water in waterworks and hydro-electric power plant, as well as hydraulic dock machinery, valves and sluices for irrigation, Venturi meters, recording instruments, and a wide range of other equipment, including valves, meters for hot water, cold water and oil, drinking fountains and fire-fighting equipment, while it may be stated that normally about 80,000 valves per annum are being turned out.

The heavy and light foundries at Kilmarnock also can be regarded as amongst the best equipped in Great Britain, taking castings up to 30 tons with a crane power of 60 tons capacity, while a notable section is the hydraulic research laboratories, on the most extensive scale, in which some very fine work has been carried out, including, for example, the recent invention of the "Glenfield" jet disperser. This represents one of the greatest advances made in water engineering for many years, whereby the energy in escaping jets of water, even to the extent of thousands of horse-power, can be distributed harmlessly, the action being on the free vortex principle, so that the solid bore of water is broken up into billions of drops, each of which is cushioned against the atmosphere. For example, at the present time there is under construction two of these dispersers as an emergency installation for the Arapuni hydro-electric station in New Zealand, fitted on the end of 12-ft. pipes, each of which will pass 3,000 cub. ft. per sec. of water, that is approximately 83¾ tons per sec., equivalent to 25,000 h.p.

These new heavy engineering shops at Kilmarnock have many interesting features, and the floors, which consist of hard wood blocks laid in 6-in. concrete, are provided throughout with a complete range of permanent pipe trenches down the centre of the bays, in which are laid hydraulic pressure pipes, river-water pipes for testing, town's water mains, gas pipes, electric cables, and rain-water drains, all of which can be replaced or repaired without breaking the shop floor. Very interesting also is the special provision for the collection of "swarf," consisting in the use of large portable steel containers sunk in the floor in concrete-lined pits covered with steel gratings, and labelled with the name of the particular contents, that is, cast iron, steel and general shop refuse, for instance. The swarf from the individual machines is tipped into these containers, which, when full, are raised up by an overhead crane and transported to railway trucks for disposal, being both a neat and efficient arrangement.

With regard to some of the contracts in hand, already mentioned, it is of course only possible to indicate a few of these, but one of the most important now being undertaken is for the Cauvery Metur Dam on the Cauvery River in the Madras Province, India, near the township of Metur, which includes 16 very large free roller sluice gates, 60 ft. wide between the piers and 20 ft. deep, as well as 13 other gates, an entirely new design of emergency roller sluice gate, mechanically - operated needle valves 8 ft. 6 in. dia., and jet dispersers which will deal with 2,000 cu. ft. per sec. of water under a head of 180 ft., while the dam, about 175 ft. high, is being constructed. Further, there are included many lengths of heavy cast-iron pipes 8 ft. 6 in. dia. for the culverts, this scheme being particularly interesting because water turbines for the generation of electricity are also being installed, due to the flow and height of the water.

Also the firm are undertaking the complete pipe-line equipment, including 55 ft. isolating valves, and the latest design of stream-line self-closing needle valves for the Uhl River hydro-electric scheme in the Punjab, while they have recently supplied similar equipment for the Grampians hydro-electric scheme in the North of Scotland.

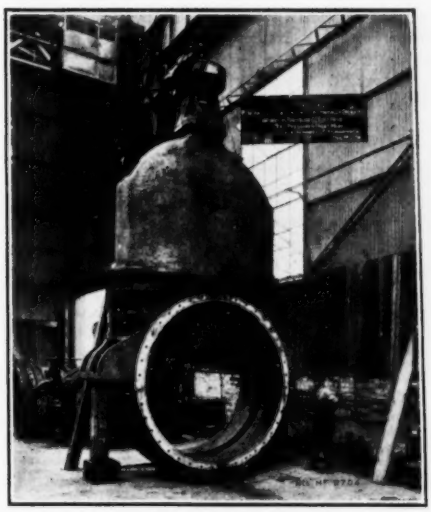


FIG. 2.—A LARGE SLUICE VALVE, MADE BY MESSRS. GLENFIELD & KENNEDY, LIMITED.

Electrically-Controlled Valves for Fen Drainage.

The principle of "distance" electrical control for water and steam valves is now being more and more adopted in many different fields, and in this connection we are able to give some details of a notable installation of large sluice valves, 8 ft. 6 in. dia., that has been supplied to the Middle Fen Drainage Scheme in Norfolk.

For this undertaking Messrs. Gwynnes Pumps, Limited, of Lincoln, have manufactured extensive pumping equipment, and three 8-ft. 6-in. dia. sluice valves have been supplied by Glenfield & Kennedy, Limited, of Kilmarnock, for attachment to the pump discharge (see Fig. 2). They are a very fine example of the latest British practice in the field of electrical control and operation, each valve weighing 34 tons, and having an overall height of 24 ft. 8½ in., with a working pressure of 22 ft. head and a test pressure of 60 ft. head.

The construction throughout is of cast iron, with the body made in two halves to allow of easier transport, and the high-grade character of the castings will be obvious, being of the finest grey iron moulded in dry sand to produce a smooth finish. Also the doors are of the parallel face type, provided on each side with solid gunmetal rings, corresponding to similar rings on the body, all of which are pinned in position, machined, and then hand-scraped to ensure a perfect bearing. Further, in order to reduce the power consumption to a minimum,

(*Concluded on page* 28.)

The German Iron and Steel Industry.

A considerable amount of public interest has been raised in Germany by the publication in the form of a volume of over 400 pages of a Report on the German iron and steel industry by Prof. H. Hummel (doctor in engineering), Herr Eugen Kongeter, Herr Karl Lange (machine constructor), Prof. Rudolf Meerwarth and Dr. Neu (scientific secretary and author of the Report). The Report forms one of a series which have been issued in the course of recent months by the Inquiry Committee (a committee for the investigation of the conditions of production and sales in German economy). The inquiry covers a period extending over three years.

In brief, the Report comes to the conclusion that the German iron industry is much too large and in part has been wrongly built up; that from a national economic point of view it is uneconomical, and from a private economic standpoint it is only remunerative in connection with its auxiliary industries, as well as the wide interests in the finishing branches. Above all, it only pays because it overcharges consumers, which it is able to do owing to the possession of a monopoly. All these charges are set forth and explained in detail in the Report. During the past three years the iron and steel industry has had every opportunity of putting its case before the Committee, but it was only toward the end of December, immediately before the publication of the Report, that the Association of Iron and Steel Producers—apparently having obtained possession of an early copy—sought to get a postponement of the publication of the volume on the ground of inaccuracies and consequent erroneous conclusions. The representations made to this effect proved to be of no avail, and the Report was duly issued. On the same day a statement on the question was made on behalf of the Association of Iron and Steel Producers.

According to the statement, there are a few main points which are the object of contention. In the first place, there is the question of productive capacity; the Report studiously avoids to use the word "over-capacity," but reproaches the industry with having unduly inflated its capacity. Yet the capacity of the present German Customs area is said to be only 58,000 tons of crude steel per working day, as compared with 73,000 tons in the pre-war Customs area. Calculated for the year, there is a reduction in capacity of 5,000,000 tons, or over 20 per cent.; and even after the return of the Saar district there will still be under-capacity to the extent of almost 3,000,000 tons, or 15 per cent., as compared with pre-war.

Permanent Difficulties.

Another point relates to the so-called "permanent difficulties" of the steel industry. The Association of Iron and Steel Producers states that the Report contends that the difficult conditions under which large sections of the iron industry work are determined not by the trend in trade, but, on the contrary, by the economic structure of the industry, which is therefore a permanent feature; the possibilities of reducing costs of production are limited. It is admitted that the structure of the industry has been changed, among other factors, in consequence of the Treaty of Versailles and the loss of the Lorraine works, the Upper Silesian coal mines, the veto on the production of arms and ammunition and through the enhanced competition of an enlarged and favoured industry in France, Belgium and Luxemburg. The costs of ore in Germany are higher; they constitute one-third of the total costs of rolled products.

But, it is complained, the Report for all that takes no notice, nor of the influence of politics and administration. It merely contents itself with the ascertainment that the average labour earnings in the North-West district between 1913 and 1927 have increased by 57.4 per cent., and between 1913 and 1929 by 71.9 per cent. On the other hand, it is pointed out that the prices of bars since 1925 have only risen temporarily by 5 per cent., but have since been reduced. The present rate (when the Report was compiled) for bars only amounts to 102 per cent. of that in 1925, while the price of coke is almost 10 per cent. lower than in 1925. To-day politics directly influence cost prices to a much greater extent than the costs of raw materials and the capital charges. Two-thirds of the total costs are dependent upon German politics and public economy.

Financial Aspects.

A further point concerns the capitalisation and financing of the iron and steel industry and the ancillary mining industry. The Report is based on what is described as the "monstrous" reproach that the industry has financed its plant values by short-term loans, that the industry itself has depreciated part of its own plants, and impaired the general economy in its output capacity and in its international competitive power; in the usual way, the plants have been burdened with depreciation applying to works or departments which had been stopped. In reply to this, the Association states that, as a matter of fact, the Vereinigte Stahlwerke (United Steel Works Corporation) have not included the stopped works in their balance-sheets. It is further stated in the Report that it requires serious consideration as to how far the measures of rationalisation have taken place in accordance with the capital situation of the German economy or can be brought into agreement with it. This opinion is based upon the capitalisation as shown in the balance-sheets of several of the alleged most important companies for the years 1925 and 1929, the figures in which are said to be stated incorrectly in each case. According to the Report, the investment values of the iron and coal concerns have increased since 1925 by 986 million mks., but the actual increase has been only 358 million mks., the yearly increase in the values of the plants having been only 6 per cent., and this with a smaller call on German than on foreign capital. The share capital is said in the Report to have risen by 617 million mks., but the Association submits that the amount has actually decreased by 28 million mks. Not a penny of short-term credit has been taken up for the financing of the plant values, and stopped works or departments have not been included in plant values By means of reconstruction and new additions—the Association states—the plants have not only not partially depreciated, but, on the contrary, have been maintained and increased in their aggregate value.

The Report comes to the conclusion that the situation of the iron industry is serious. With this assertion the Association fully agrees, but the causes of this serious situation are said to be quite other than those to which the Report ascribes the present state of affairs. The German steel industry will not allow the Report to pass unchallenged, and will approach the Government in the matter if the necessity arises.

Aluminium Plating of Iron.—A Stockholm metallurgist has recently patented a method of aluminising iron at a temperature of 900 deg. C., which makes the iron resist rust, oxidation and the influence of corroding gases and fluids. Through the new process the aluminium does not only cover the surface of the metal but partly permeates the iron, thus forming a bond of great resistive and protective power. This process, after having been tested by the Sandviken Iron and Steel Works, has yielded such good results that the Sandviken concern has acquired the sole rights of using it for cold-drawn and rolled tubes and cold-drawn hoops, etc. The invention is being exploited by a new company, the Aktiebolaget Stockholms Aluminiseringsfabrik.

Birmingham Central Technical College.

METALLURGY DEPARTMENT.

On the occasion of the prize distribution at the Birmingham Central Technical College recently, the various departments of the College were open to inspection by the public, and interesting displays were given in the laboratories.

In the Department of Metallurgy, the various testing machines, pyrometers, electrically-driven rolling mill, etc., were used for demonstrations. The high-temperature recuperative gas-fired furnace was used in connection with making sand castings, etc., and there were various exhibits illustrating the manufacture, uses and properties of metals and alloys, electro-plating and metal colouring and the microstructure of alloys. A special exhibit by Messrs. The Mond Nickel Company, Limited, "The Versatility of Nickel," attracted much interest. The pyrometers were under the care of Mr. E. R. Taylor, A.R.S.M., the electro deposition and metal colouring under Mr. C. R. Clark, and the metal melting and casting under Mr. W. Lawson and Mr. S. J. Dangerfield.

By the courtesy of Messrs. The British Oxygen Company, Limited, a special demonstration of metal cutting by means of the oxy-coal-gas flame evoked great interest. Mr. Crowe, the firm's representative, arranged for this demonstration to be continuous throughout the evening, and in addition carried out a number of interesting experiments with liquid oxygen. Mercury was frozen in liquid oxygen and subsequently hammered out to demonstrate its malleability.

Dr. D. Stirling Anderson, the new Principal, in referring to the work of the past session, pointed out that in numbers of students the Department of the College was the largest of its kind in the country. This session a new course leading up to the National Certificate in Founding has been commenced, and a large number of students has been enrolled in the classes which the course comprises.

The Heavy Shops of Messrs. Glenfield & Kennedy, Limited.

(*Concluded from page 27.*)

ball-thrust washers are provided on each side of the collar of the screwed spindle, and on the usual lines operation is by means an electric motor through spur-and-worm reduction gearing. Great attention also has been given to the lubrication of all parts of the operating gear, the worm being totally-enclosed in an oil-bath, and grease-cups and lubricators fitted on the bearings.

It may be stated that Messrs. Glenfield & Kennedy, Limited, at the present time are producing about 240 tons a week from their foundry, which employs 290 men, while in the shops, behind the Middle Fen drainage valve, are seen balanced disc valves for the Uhl River hydro-electric project in the Punjab, for operation under 530 ft. head, with a test pressure of 765 ft. head. These valves will be fixed at the head of the pipe-line, acting as guard-valves to automatic self-closing valves, also being supplied by Glenfield & Kennedy, Limited.

An extraordinary general meeting of Tube Investments, Limited, held recently, at Birmingham, passed a resolution authorising an increase of capital from £2,723,268 to £2,973,268, by the creation of 250,000 new shares of £1 each. It was explained that the new capital authorised was not in the nature of a public issue or an issue to the shareholders, but was required in part to provide for carrying out relatively minor operations that were to be effected by acquiring interests in other undertakings. At the present moment only a small portion of the new capital was needed.

Foundries—and Foundries.

DESIRABILITY OF ACCURATE COSTING STRESSED.

At a meeting of the Lancashire Branch of the Institute of British Foundrymen, held on December 6 at the Manchester Muncipal College of Technology, the Branch-President, Mr. R. W. Stubbs, in the chair, MR. S. H. RUSSELL, of Leicester, read a Paper entitled "Foundries—and Foundries." This appeared in our issue of January 1.

Vote of Thanks.

In moving a vote of thanks to the author, MR. E. FLOWER said he quite agreed that in calibre the apprentice of to-day was quite equal to the apprentice of 30 or 40 years ago, but he was serving his apprenticeship in an atmosphere of rationalisation, repetition and mass production. One great difference was that formerly the moulders moved about much more freely from shop to shop and district to district, thereby gaining a greater and more varied experience.

The vote of thanks was passed unanimously.

MR. RUSSELL replied that he had tried to indicate three or four things which applied generally to every foundry and which he thought could be remedied. Rationalisation must be carried out intelligently. He recalled a case in which it was found unprofitable to work a big cupola which delivered the metal into the foundry, so a small one was built. For some obscure reason it was placed in a position which made it necessary to carry every ounce of metal through the yard to reach the foundry.

DISCUSSION.

Survival of the Fittest.

MR. W. JOLLEY, opening the discussion, said that during the last few weeks he had frequently discussed this subject with his colleagues upon the lines that Mr. Russell had followed, but Mr. Russell had given them new points to consider. A great deal had to be done to improve the foundry industry, and for a long time the idea had been in his mind that foundrymen might get together with a view to eliminating the inefficient among themselves. Suppose some foundries worked together and one set of accountants looked after the accounts of all. It might be termed forming a ring, but he did not like that word. His idea was that each foundry should compete for orders. If the successful firm made a profit they would be at liberty to compete the next time. If they made a loss they would be penalised in the next competition for an order. By that method the most successful foundries would be kept going the whole of the time and the most inefficient would ultimately go out of business, to the benefit of their colleagues and themselves. Had Mr. Russell given any thought to that idea? If so, would he state his views?

Co-operative Costing Bases.

MR. RUSSELL said his firm sold castings on the open market, so the problem Mr. Jolley indicated had faced him for a long time. He did not like the word "ring." What he had had in his own mind was the practical system outlined in what was said by Dr. Geilenkirchen about the German Association. To some extent costing was an approximation: one could not estimate exactly the actual expenditure on any casting; a certain amount of it had to be guesswork. Having agreed on a satisfactory basis of costing, the foundrymen in a district banded themselves in an association. If one of them took a job on in open competition at what his fellow-foundrymen thought was an unremunerative price, he must prove that he could make a profit. If he did so, good luck to him. The man who could produce most economically ought to have the work. He (Mr. Russell) did not believe in rings which bolstered up the inefficient. That happened in many associations; a price was fixed at which the inefficient could earn a profit and the efficient got a bigger profit. Ultimately that was to the disadvantage of the industry. The product became too dear and a substitute was found, and sooner or later the ring collapsed. Therefore he did not advocate fixing a price at which to sell, but he did think that every foundryman should be able to justify the price at which he sold and prove that he was not giving anything away but that he could produce profitably on that basis.

All foundries tended to specialise; one was better laid out than another for producing certain types of castings. Even in jobbing foundries that tendency was apparent in regard to certain things which the particular foundry could produce economically. The greatest damage to the industry was done by the man who took on jobs without the faintest idea what they would cost him until they were finished. Even then he did not always know that he had lost money on that particular job. That position arose from failure to understand and study a proper system of costing. As far as he could see the industry would only become sound when the responsible people agreed that if necessary they would exchange their costings upon any article in which they competed. When the inefficient foundry took a job at the same price as the efficient foundry it was unwittingly losing money; instead of keeping on in that way and arriving in the Bankruptcy Court it should be pulled up promptly and turned to something on which it could make a reasonable profit.

MR. JOLLEY said "ring" was not the right word to describe what he had in mind. The object of his proposal was to produce greater efficiency. If a neighbour, by altering his plant, so cheapened his production that he could sell at a lower price and make a profit he would retain the business. The man to cut out was the man who was losing. He should be stopped from quoting to customers something which he could not supply to them a second time at the same price. That was misleading the customer who might book an order on the assumption that he could get his material again at the same price and find that he was let down.

Careful Estimating Essential.

MR. G. HALL said Mr. Russell had given them something very important to think about, particularly the part of his Paper in which he mentioned estimating and costing. Foundries are suffering to-day from the lack of costing and finding what a job should cost. Unfortunately, many foundry executives did not know, or would not take the trouble to learn, what a job would cost before making. They preferred to look at a pattern and then say, "I can make it for so much per cwt." He (Mr. Hall) would defy any foundryman to calculate the weight of a casting by just looking at the pattern. Unless a man knew the actual weight of a job and its cost, he would not know what would be the value of that job.

The other day, when calling on a customer who wanted to know a spot price for four castings, he (Mr. Hall) said he would send in a written quotation, but the customer replied: "Mr. —— had been, and given a price by just looking at the pattern." He answered: "Give Mr. —— the order; I cannot afford to risk losing money by giving a price immediately."

What was wanted in the foundry was for every job to stand on its own footing, and not one job help to pay for another, as invariably occurred in a price per cwt.

Mr. Hall went on to say that at the end of every month his firm was able to give figures on every job, whether it had lost or made money. They were jobbing founders, and did not specialise in any particular work.

Concerning the suggestions made for "rings" for the control of the trade, he had no time for them. Some years ago his firm were connected with a trade association. After attending three meetings, and at each meeting the representatives quarrelled because members were selling castings under the prices agreed and fixed by that association, they left the association.

Spot prices and prices per cwt. put many foundries out of business. The speaker's firm based their prices on what the job was going to cost, and they could always tell whether they were making or losing money, and to-day they were not losing money.

MR. RUSSELL: There is no doubt you cannot trade successfully unless you have a system of costing with regard to the jobs you make. The great need is that every responsible person in the foundry should have full access to all costings in order to check their estimates and prices.

MR. E. FLOWER said the foundry industry was in dire need of a proper costing system. A few weeks previously he started to put on paper his views upon this subject, but after consulting several influential people, he decided it was too dangerous a topic upon which to give a Paper. The general shortage of trade was not the sole reason for the present position of the foundry industry. Foundrymen themselves were mostly to blame.

A Qualification for Foremanship.

MR. A. SUTCLIFFE said a man who could not give a price for a job whatever it was, was not qualified to be a foundry foreman. It was much easier to give a price by looking at a pattern than from a drawing, and the foreman ought to be able to tell to an hour or two the time it would take. That statement he made from experience of all kinds of jobs, varying in weight up to several tons. He quoted for many dozens of jobs of all sorts, in a week, and, of course, there was always someone who could do it for less. Some people would do a job cheaply, with a notion that they would get the next job from that quarter. They did not always do so. He remembered one instance in which his price was £20 more than his competitors, but he got the order on account of the difference in the quality of the castings. It should always be remembered that, if one could not make a job pay, one would not be able to go on.

Of course, his foundry was very different from Mr. Jolley's. He did not employ mechanical aids. That was all he needed. Machinery did not always serve a useful purpose in a jobbing shop. In one case, where a sand conveyor was installed, he thought it did more harm than good. A simple thing for stopping the swirling of metal was by dropping the feeding rod in the git bush while the metal was being poured from the shank or ladle.

Economic Application of Machinery.

MR. RUSSELL agreed there was a difference between looking at a pattern and looking at a drawing, but it was better to put on paper the weight and other information and figure out what it was going to cost rather than look at the pattern and make a guess. Admittedly some men were very skilful in their estimates, but it was not a good plan.

He did not advocate putting in machinery which was not going to do the job efficiently and economically. For instance, a sand conveyor should be installed only when it was known that a sufficient saving would be made to provide for the capital outlay and for depreciation. There were thousands of jobs in respect to which it did not pay to put in a sand conveyor. On the other hand, in the particular job he had in mind the output was increased 40 per cent.

with two machines, and there was a distinct saving.

Mr. Sutcliffe referred to the practice of putting the feeding rod in to stop the metal swirling round. He (Mr. Russell) had noticed that when the men lifted the stopper off the runner they did not take it right out of the bush; they left it so that it was on the surface of the metal, and it had the same effect as Mr. Sutcliffe described. It stopped the swirling of the metal.

First Costs the Basis of Estimates.

Mr. Longden said he thought that the object of the Paper was to stir up the foundry trade with regard to costing and education rather than to interest the audience in the technical side of the industry. The lack of knowledge of costing among foundrymen was amazing. Recently a foundry was running metal castings, the mixture being 50 per cent. pig and 50 per cent. scrap. They took those figures in the costing, forgetting that probably from 30 to 40 per cent. of scrap is returned, leaving only 15 or 20 per cent. of new scrap introduced into the casting. When that happened in many cases there was a serious discrepancy at the end of the year.

He quite appreciated Mr. Sutcliffe's point with regard to the foundry foreman or manager being quite capable of estimating the cost of a casting. In spite of all improvements in costing systems the experienced practical man was still the best man to assess the price of a casting. But he would be much helped in his calculation if he was furnished with sufficient information by the costing department regarding on-costs. Many times he himself had scaled down, or lifted up, or rectified the costing got out by the estimate department. In the first place the basis of the estimate should be the calculation of the foreman or manager of the first costs.

Rationalisation, he supposed, meant that the foundry would be worked on the most economical lines; it did not mean necessarily it was going to have conveying plant or mass-production plant. Those things had their proper place. Some firms could work successfully on mass-production lines, but it was not so with others whose work was of a jobbing nature.

Estimating Dependent Upon Costing.

Mr. Russell said the purpose of the Paper was to define or to focus attention upon some particular method of costing which could be commonly adapted to all foundries. That was one of three things he had in his mind when he wrote the Paper. Efforts were being made to promote education in the foundry, but he considered the problem of training moulders had not been taken up at all in the discussion. He had also thrown out a hint which did not seem to have been discussed, about the slogan, "The customer is always right."

There was a difference between costing and estimating. He considered costing was the word to use when figures were being got out after the conclusion of a job, to ascertain whether a job had paid or not. If it had not paid or if there was excessive scrap that would be quickly indicated. An estimate was based upon a summary of information so obtained. Unless the costing was properly done one could not properly estimate.

Each Casting Should Yield Profit.

Mr. R. A. Miles said a great deal had been said about foundry equipment and costing, but very little about the actual founders—the men. He had been under the impression that the title of the Paper was "Foundries and Founders." He himself had known several men of outstanding ability who could give an estimate of a job to the entire satisfaction of the employer. The cost depended upon the time in which the man was going to make the casting, and the way he could adapt himself to the tackle in the shop in which he was working.

Most of the members would understand that a job given to one man would not be done either so well or so cheaply as by a man of outstanding well-known ability. There was such a thing as pride in foundry craftsmanship, but in these commercial days the foundryman had to live, and to do so he had to make his castings as cheaply as possible, but it was a mistaken policy to sell cheaper than cost. Some foundries evidently did this and endeavoured to balance the debit from some other job on which they were able to obtain a good price. Of course this was a very bad policy. It ought to be a rule that each job must be properly costed by itself, and everyone should endeavour to make a reasonable profit on each casting which was made in their foundry.

The slogan, "A customer is always right," was correct, but at times it might be necessary to persuade the customer to take something different from what he asked for, sometimes in order to earn a little extra profit for the firm and in other cases to prove that the alternative article was a better product. Of course the customers were free to go to any firm for castings, but it was usually an advantage to place their regular orders through one firm. In this way they would be sure of getting the right kind of castings and regular deliveries and attention.

The Apprentice Problem.

Mr. A. Jackson said he was inclined to think the present-day apprentice was superior to the apprentice 30 years ago, because he had had better educational facilities and the general tone of the people as a whole had been improved. If that better type of boy was got into the foundry would he stay there? Moulding classes for moulders were needed. The change in the position now from what it was 30 years ago must be considered. In those days the typical moulder had had experience in many shops: he had travelled from one place to another. To-day it is not so easy to change from one works to another. Consequently the lad who wanted to learn moulding was largely dependent for his knowledge upon the shop in which he was engaged during his apprenticeship days. The best use must be made of the facilities afforded; it must be impressed upon the boy who was looking forward to becoming a moulder that if he could not get practical knowledge of a very wide series of work he must attend the classes which were taught by practical men. When these youths had been trained as apprentices they were wanted as moulders, but they often gravitated elsewhere. It would be as well to concentrate a little on teaching them that there were opportunities in the foundry as well as outside. A lad of the better class, who had intelligence, looked round and thought he was in the wrong situation, partly because it was not brought home to him how important the foundry was and the part it played in the engineering industry.

Mr. Russell said during the present depression in trade he had had this experience. Taking a broad view, men who had been with them longest were the most skilled, the best men, but when it was necessary to give to them jobs different from those they had before they did not get on very well; there were many wasters, in some cases an alarming number. Staff and output were reduced, but the output cost more than it ought to do because the right men were not making the right jobs.

Producing Qualified Moulders.

As Mr. Miles said, the foundryman must make a profit. That was essential in order to obtain new plant and new tackle and keep the premises up to date. Subject to that necessity for a reasonable profit, one should sell as cheaply as possible. That applied to every industry.

In his address he tried to point out that as far as he could judge the average boy in the foundry to-day was no worse than the boy of 25 or 40 years ago. By that he meant that the boy appeared to have about the same status and the same moral outlook, but he had the advantage of a considerably better education, and for that reason he should be superior. The awkward thing was that the boy was not turned into a superior moulder. He (Mr. Russell) had indicated that a scheme was necessary whereby every foundry would be responsible for training 5 per cent. apprentices. Suppose it had 20 moulders. Every year one boy would be brought along so that he became a qualified moulder. In 20 years there would be 20 qualified moulders. As far as he could see in his admittedly limited experience the only way to make a satisfactory moulder was to give the boy facilities to work with a moulder engaged in producing castings. That could not be done right up to the age of 21, but it could be done for the first year or two, or even three.

Moulding classes for moulders was a very big subject. He held the theory that one could learn the technical side at a technical school, but the only place to learn practical moulding was the foundry.

The Chairman said a point which struck him was this. Suppose a boy worked with a good moulder and was trained till he was 18 or 19. After he had become efficient he left. What compensation had his employer for the time and worry and for the training given to the boy?

Reference had been made to 500 foundries going out of existence. He was not surprised when he considered the prices at which some people sold castings; it surprised him that more foundries did not go out of existence.

Then with regard to the slogan, "The customer is always right." Bad castings were sold occasionally, and if the customer sent them back the foundryman had no option but to admit the customer was right. To say he was wrong or to argue with him might irritate him and lose his order.

Training Moulding Strength.

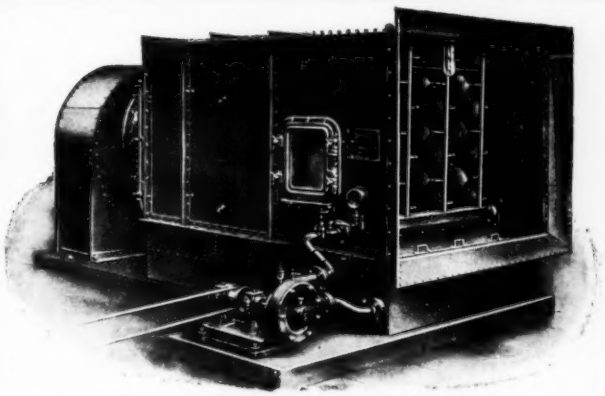
Mr. Russell said when the majority of the foundries carried out the policy of training 5 per cent. of their moulding strength per annum, if one of them lost a boy they had trained probably another would come along who had been trained elsewhere. He heard that objection raised in a discussion about training apprentices in electrical engineering, and in reply it was urged that a boy who went elsewhere at the end of his training was a valuable missionary advertising the place where he was trained. If he had been treated fairly he always had a good word to say for it.

If the foundryman tried to persuade a customer he was wrong, to question the design and ask what the casting was wanted for, and so forth, the customer would probably go to someone who would be content to produce what he was asked. Even if it was thought a casting would not prove very satisfactory for its intended purpose the wisest policy was to carry out the customer's instructions and make it. Otherwise the customer might think the foundryman could not do it. Tell him, "We think you are wrong, but we will make it somehow."

Improvement in Saw Steels.—An attempt to obtain high strength and high values for the other essential properties has resulted in adopting nickel-molybdenum steels for saws, both elements being present in small amounts. The elastic limit can be made high without sacrificing ductility and toughness. The elastic and ductile properties of steel make possible the tensioning or prestraining treatment essential to a band or circular saw. Mechanical tensioning is done by hammering or cold-rolling selected areas of the saw. The cold working elastically expands the steel adjacent to the spots where the force is applied, the later spots being stretched permanently. A steel low in ductility can be given but little deformation by cold working without dangerously approaching the breaking point. A phase of ductility, the ability to be cold worked without rupture, is an essential property of solid-tooth saws whose teeth are swaged for clearance.—"Steel."

TRADE SIROCCO MARK

HEATING and VENTILATING EQUIPMENTS



Sirocco Air Washer for cleaning the Air supply.

Central Heating Plants on the hot air principle for large or small buildings, providing an ample supply of pure fresh air at any desired temperature.

Steam Turbine Heater Units in which the steam driving the Fan heats the air supply. A simple and effective method of supplementing an insufficient heating plant. Send for Catalogue No. 8.

DAVIDSON & CO., LIMITED,

Sirocco Engineering Works —— Belfast.

LONDON, GLASGOW, CARDIFF, BRISTOL, MANCHESTER, BIRMINGHAM, NEWCASTLE.

SIEMENS' STEEL PROCESS

BOILER, SHIP and BRIDGE PLATES, etc. ANGLES and all forms of Sectional Bars. TYRES and AXLES to all requirements. CASTINGS of all kinds and of Largest Sizes. FORGINGS of every description. BILLETS, BLOOMS, RAILS.

SPECIAL STEEL FOR CONSTRUCTIVE PURPOSES.

The STEEL COMPANY OF SCOTLAND, Ltd.

Head Office: 37, RENFIELD STREET, GLASGOW:
Works: HALLSIDE, NEWTON and BLOCHAIRN, GLASGOW.

CONTRACTORS TO HOME, COLONIAL AND FOREIGN GOVERNMENTS.

Established 1872. ***Telegraphic Address: "Steel, Glasgow."***

GANISTER, CUPOLA BLOCKS, FIRE BRICKS,

FIRE CLAY.

Silica Bricks, Tuyeres, Stoppers, Nozzles, &c.

STEEL MOULDERS' COMPOSITION, SILICA CEMENT.

J. GRAYSON LOWOOD & CO., LTD.

DEEPCAR, nr. SHEFFIELD.

Telegrams: "LOWOOD, DEEPCAR."

Trade Talk.

The output of Clyde shipyards in 1930 was 246 vessels of 529,744 tons, compared with 222 vessels and 565,798 tons in 1929.

The directors of the Great Western Railway have authorised the building at Swindon in the present year of rolling stock and locomotives to cost £1,199,000.

The office of the Muirhall Foundry at Larbert was broken into recently, and an attempt made to remove and open the safe. The intruders succeeded in getting the safe into the foundry yard, but their efforts to break it open with a piece of iron failed.

Operations at the Llanelly steelworks of the Llanelly Steel Company, Limited, were restarted on December 29 after several weeks' idleness in consequence of trade depression. The company's sheet mills, which had been idle for some months, were also restarted.

The new motorship "Anshun," built by Messrs. Scott's Shipbuilding & Engineering Company, Greenock, for the China Navigation Company, London, has completed successful trials in the Firth of Clyde. The vessel is fitted with a new design of oil engine developed by the builders.

Messrs. Alloy Welding Processes, Limited, and the Premier Electric Welding Company, Limited, have been amalgamated, and the new company, which operates as from January 1, 1931, is named Murex Welding Processes, Limited. The address of the offices and works remain unaltered.

Mining & Industrial Equipment, Limited, 11, Southampton Row, London, W.C.1, report that orders have been received for four Hum-mer electric screens and eight mills, for use in England in screening and grinding coal, coke and clinker. An order has been received from Japan for a mill to grind copal gum.

It is reported that the wire-rope works in Collingdon Road, Cardiff, formerly carried on by Messrs. George Elliot & Company, Limited, which closed down in October last, has been acquired by Messrs. Bruntons, of Musselburgh, and Mr. Kenneth Davies, of London, and will be re-equipped and restarted as soon as possible.

We are informed that Messrs. Krueger & Toll, the powerful Swedish group which has made a practice of lending millions to various European Governments and controls the match monopolies of several countries, has now, after careful investigation, acquired a substantial interest in the Brackelsberg process for the melting of iron and steel. This foreshadows rapid development, which may be of considerable later interest to our readers.

The Executive of the Federation of Engineering and Shipbuilding Trades, meeting in London recently, considered a letter from the Engineering Employers' Federation, inviting the unions to a conference this month to discuss the position of the engineering industry and the question of production costs. It was decided that a fuller conference of the unions concerned should be convened. Representatives of the unions accordingly met on December 30. They decided to meet the employers.

The British Mannesmann Tube Works, at Landore, Swansea, which employs about 1,200 men and has been the centre of a dispute since November 15, was reopened on December 29. The resumption, which was made as general as possible, was decided upon as the result of negotiations between the company and the men's representatives in London. The dispute arose over new proposals of the company concerning the men's hours of work and rates of pay.

Contributions to hospitals and charitable institutions in the West of Scotland have been made by employees of the following firms:—Fullerton, Hodgart & Barclay, Limited, Paisley, £41; William Baird & Sons, Limited, Temple Iron Works, Glasgow, £42; North West Rivet, Bolt & Nut Company, Airdrie, £69; Coltness Iron Company, Limited, £4,233; Drysdale & Company, Limited, Yoker, £264; William Denny & Company, Dumbarton, £397; Clyde Structural Steel Company, Limited, Whiteinch, £55; A. F. Craig & Company, Limited, Paisley, £103; Springfield Steel Company, Limited, Glasgow, £63; Glencairn Metals, Limited, Motherwell, £32; Blantyre Engineering Company, Limited, Hamilton, £63; Smith & M'Lean, Limited, Glasgow, £620; Lion Foundry, Kirkintilloch, £98; Southbank Iron Works, Kirkintilloch, £91.

The contract for the erection of a new bridge over the River Foyle at Londonderry has been awarded to Messrs. Dorman, Long & Company, Limited, at £255,510. The work is to be accomplished in thirty months. It is also announced that the tender of Messrs. Dorman, Long & Company, Limited, for the construction of the Newport Bridge across the River Tees at Middlesbrough, at a cost of approximately £500,000, has been provisionally accepted. When completed this will be the largest and heaviest lift bridge in the country, the weight of the lifting span alone being 2,500 tons. The passage provided for shipping will be 250 ft. wide, with a clear headroom of 120 ft. The hoisting will be carried out by means of 160 steel-wire cables, each 7¼ in. in circumference, working in cast-steel sheaves at the tops of towers 160 ft. high. Included in the contract are ten further approach bridges, five on each side of the river, over L.N.E.R. tracks, roads, etc., and a length of embankment.

Obituary.

Mr. J. P. MacTaggart, for many years manager of the Cardiff branch office of the English Electric Company, Limited, died recently.

Mr. James Starkey, a director of Messrs. William Foster & Company, Limited, engineers, Lincoln, has died at the age of 67. He had been connected with the firm for about half a century.

The death occurred, on December 21, at Johnstone, Renfrewshire, of Mr. George Barclay, a prominent figure in Scottish commercial and industrial circles. He was for over 40 years a director of Messrs. Fullerton, Hodgart & Barclay, Limited, Vulcan Works, Paisley.

Mr. Charles Kerslake Baker, an analytical chemist well known in Sheffield, died on December 27, aged 72 years. Mr. Baker was educated at Wesley College and the Royal School of Mines, and was a Fellow of the Institute of Chemistry. His work as a metallurgical chemist brought him into close touch with many of the Sheffield steel firms, and for a considerable time he also held the appointment of Admiralty chemist for the North of England.

Mr. William Altheus Caddick, a director of the Cargo Fleet Iron Company, Limited, and the South Durham Steel & Iron Company, Limited, died suddenly on December 30 at his residence in Saltburn. Mr. Caddick, who was only 48 years of age, was a member of the North Riding of Yorkshire County Council and of Tees-side Chamber of Commerce. A native of Middlesbrough, he was associated throughout his career with the Cargo Fleet Iron Company, and was appointed secretary of the firm in 1924. He was appointed to the board of directors of the Cargo Fleet Iron Company and the South Durham Steel & Iron Company last year.

Patent Specifications Accepted.

The following list of Patent Specifications accepted has been taken from the "Illustrated Official Journal (Patents)." Printed copies of the full Specifications are obtainable from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1s. each. The last numbers given are those under which the Specifications will be printed and abridged, and all subsequent proceedings will be taken.

11,052. Electro Metallurgical Company. Smelting of ores. 309,594.

17,002. Gernelle, J. E. Treating sands in foundry practice. 336,248.

17,847. Russell, Burdsall & Ward Bolt & Nut Company. Method of and apparatus for making nut-blanks. 314,066.

23,683. White, A. E. (Aluminium, Limited). Mould for casting metals. 336,337.

24,044. Lodge & Shipley Machine Tool Company. Metal-cutting and like machine-tool beds. 317,324.

36,166. Camerota, L. A. Sand-reconditioning machines for foundry art. 336,482.

38,227. I. G. Farbenindustrie Akt.-Ges. Refining magnesium and alloys thereof. 336,498.

4,552. Ternstedt Manufacturing Company. Method and means of stripping chromium plating. 336,532.

19,047. Byers Company, A. M. Production of slags for use in the manufacture of wrought iron. 315,858.

21,225. Carreras, R. S. Treatment of complex ores of copper, cobalt and nickel. 336,584.

Personal.

The patternshop of Messrs. Cruickshank & Company, Limited, Denny Iron Works, was the scene of a happy little ceremony when Mr. Robert Fernie was presented by the staff with a timepiece as a wedding gift.

Sir Harry McGowan, President of Imperial Chemical Industries, Limited, has been elected chairman and managing director of the company, in succession to the late Lord Melchett. The Marquess of Reading was elected President.

Mr. and Mrs. Matthew McNeilage, of Main Street, Bonnybridge, have celebrated the 50th anniversary of their marriage. Mr. McNeilage has been employed for the past 27 years with Messrs. Smith & Wellstood, Limited, Bonnybridge.

Mr. H. H. Ashdown, a well-known British metallurgist, has joined the staff of the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., U.S.A., as a metallurgical engineer. Mr. Ashdown had recently been connected with the physical research laboratory of the Illinois Steel Company, South Chicago.

Mr. Cyril Watts, a director of the South Wales Tinplate Corporation, has been elected chairman of the Management Committee of the London Iron and Steel Exchange, on the retirement of Mr. Watson Slack, who had held office for three years. Mr. F. Baxter, of Messrs. Baxter, Fell & Company, has been elected vice-chairman of the committee.

Mr. J. Hepworth, managing director of Messrs. Hepworth & Grandage, Limited, engineers and iron-founders, of Bradford, last year undertook his usual collection of toys for Christmas gifts to the city's poor children. Mr. Hepworth has been responsible for this work every Christmas for some years past, and states that the response of the public to his appear in 1930 was better than in any previous year, and that his associates and himself have been able to distribute toys to hundreds of youngsters in the poor districts of the city.

Contracts Open.

Cupar, January 12.—Water mains, etc., for the Fife County Council. Messrs. Bruce & Proudfoot, civil engineers, 63, Nicol Street, Kirkcaldy. (Fee £1 1s., returnable.)

Johannesburg, January 24.—24 cast-steel tramcar gear wheels, for the City of Johannesburg. The Department of Overseas Trade. (Reference A.X. 10,661.)

Manchester, January 10.—Water mains, etc., for the Public Assistance Committee. The Superintendent of Works, Public Assistance Offices, All Saints, Manchester.

Watford, January 14.—1,450 yds. of 18-in. dia. and 75 yds. of 9-in. dia. cast-iron pipe rising main, etc., for the Town Council. Mr. W. W. Newman, borough engineer, Municipal Offices, 14, High Street, Watford. (Fee £2 2s., returnable.)

Company Meetings.

Yarrow & Company, Limited.—The annual general meeting of Messrs. Yarrow & Company, Limited, was held at Scotstoun, Glasgow, recently. Mr. Harold E. Yarrow (chairman) said that the adoption of the Yarrow boiler for both marine and land installations continued to make satisfactory progress. The Cunard Company had decided to adopt them in their new Atlantic liner. The boiler department would be fully occupied for some months to come.

Crittall Manufacturing Company, Limited.—Presiding at the annual meeting of the Crittall Manufacturing Company, Limited, Sir Valentine Crittall, J.P. (chairman), said that at their factories at Braintree, Witham, Maldon, and Silver End they were possessed of manufacturing units which compared favourably with any plants either in this country or throughout the world. They had now reached a stage when they could definitely say that, from the point of view of their productive units in this country, their plans were complete, that they were functioning in a manner which accorded with their highest expectations, and that their efficiency would be further increased as total productive capacity was attained. The Darlington Rolling Mills were doing very well. The company was making good profits, besides supplying them with raw material at an economic figure.

BRITISH STEEL FOUNDERS SAY

"YORKSHIRE SAND"

(IN FOUR GRADES)

IS SO GOOD

THAT NOTHING CAN BE BETTER

ASK 'EM

SOLE MAKERS:

GENERAL REFRACTORIES LTD., SHEFFIELD.

(Tel. 22311.)

Iron and Steel Markets.

Pig-Iron.

MIDDLESBROUGH.—The influence of the New Year holiday is, of course, rapidly growing less, but its effect is still noticeable in current business. The reduction of prices announced this week, however, is expected to provide an inducement to buyers to place contracts. It was confidently anticipated that Cleveland pig-iron prices would fall. The disparity between the c.i.f. price of Continental iron and Cleveland pig was very wide. Midlands iron could also be bought at lower figures than the local product, and it was evident that, to retain even local connections, Cleveland prices must fall. At Middlesbrough on Monday, ironmasters reduced by 5s. a ton the fixed minimum quotations for Cleveland pig-iron, lowering prices to a basis of No. 3 at 58s. 6d. The reduction is expected to check buying of foreign iron by firms in this country and to release orders for Cleveland pig-iron. Conditions in the export market are still far from satisfactory. The outlook is poor, and until there is an upward movement abroad, Cleveland producers may have to remain content with orders from the home market. Prices this week are lower by 5s., as follow:—No. 3 Cleveland G.M.B., 58s. 6d.; No. 1 foundry iron, 61s.; No. 4 foundry, 57s. 6d.; No. 4 forge, 57s. per ton.

Business in hematite has been quieter. Unfortunately, substantial additions have been made to stocks at makers' works during the past few weeks, and, until they are liquidated, they must prove a source of weakness. However, one hematite furnace at the Normanby Ironworks of Messrs. Pease & Partners, Limited, has gone out of operation for relining, and, as only seven hematite furnaces now remain in blast, a gradual reduction of unsold iron should be possible. Prices are expected to fall, but at present, for prompt parcels of East Coast mixed numbers, sellers are quoting 70s. per ton, and for No. 1 quality 70s. 5d. On the North-West Coast, Bessemer mixed numbers are quoted at 70s. per ton at works.

LANCASHIRE.—Business in foundry iron has not been good in the past week, transactions being comparatively few. Sellers, however, seem to have hopes that the worst of the depression is over. This will depend largely on the position of the textile machinery manufacturers. With regard to prices, the position is unchanged. For delivery to users in the Manchester price zone, both Derbyshire and Staffordshire brands of No. 3 are quoted on the basis of 69s. 6d. per ton, with Northamptonshire iron at 68s. Values of Scottish pig-iron, for delivery equal to Manchester, range from about 90s. 6d. to 91s. per ton. The demand for West Coast hematite is also very slow.

THE MIDLANDS.—Quiet conditions prevail in this area. To a large extent the business now being transacted is confined to small requirements for immediate needs. As prices will come under review again soon, consumers refrain from ordering forward to any extent. Values are unchanged meanwhile at 67s. 6d. for No. 3 Northants and 71s. for Derbyshire and Staffordshire No. 3, these figures including delivery to local stations.

SCOTLAND.—Little business has been done during the past week. Another furnace has been blown out, leaving only five in operation, one being on hematite and the others on foundry iron. It is deplorable that there is not sufficient demand to absorb such a reduced output. There is no change in prices, and No. 3 Scotch foundry iron remains on the basis of 76s. 6d. f.o.t. furnaces, with the addition of 2s. 6d. per ton for No. 1 quality.

Finished Iron.

Conditions remain extremely quiet, and, unfortunately, there seems no prospect of a real improvement at an early date. In the meantime, prices are unchanged, crown bars from the Staffordshire area being at from £9 15s. up to £10 5s., and nut and bolt bars from £8 15s. to £9. In connection with the latter, very little business is moving, chiefly on account of the continued low prices at which Belgian iron can be imported. The foreign works are quoting £4 4s. 6d. f.o.b. Antwerp, or, roughly, £5 5s. delivered in South Staffordshire, and at this rate they secure the bulk of the business in common iron. The makers of marked bars continue to quote £12 10s. at works, and whilst business is not so good now as it has been, there is a reasonable hope that conditions will improve.

Steel.

Few large specifications are being given out by structural steelworks at the present time, although there is welcome news that some large contracts have been placed, which will help the situation. All the steelworks are sparsely occupied, and none of them has heavy bookings for forward delivery. Almost any type of specification is being accepted to ease the situation. The semi-products market is very quiet. The demand is usually small at this time of the year, and much of the inactivity of the market is due to seasonal causes, but it does not appear that much expansion of trade can be expected just yet. Most consumers have covered their requirements.

Scrap.

Very little business has been done in iron and steel scrap in the Cleveland district this week, but hopes are entertained of a greater activity in the near future. Prices remain at 50s. for ordinary heavy cast iron, 50s. and 52s. 6d. for machinery quality in handy sizes. In the Midlands the position has been much the same. There is still great difficulty in getting deliveries forward. Heavy machinery cast-iron scrap is offered at 60s. delivered, and ordinary heavy metal at 57s. 6d., with light cast-iron scrap at 45s. delivered. In Scotland, business has until recently been entirely suspended owing to the holidays. Owing to the acute depression, most of the works were idle for an extended period. The prospects of an early improvement in the iron and steel trade of Scotland do not seem bright. First-quality machinery cast-iron scrap, suitable for foundries, is at 55s., with ordinary cast iron to the same specification at 51s. 3d. to 52s. 6d., cast-iron railway chairs 55s., light metal 40s., and furnace firebars at 37s. 6d. The above prices are all per ton delivered f.o.t. consumers' works.

Metals.

Copper.—Business has been interrupted by the holidays, but lately there has been an increasing volume of orders from consumers, who have doubtless been impressed by the firmer tendency of the market. Standard copper has recently been more firm. Reports from the United States suggest that consumers there are showing a livelier interest, especially in connection with electrical work, and it is also worth recording that representative copper-mining shares have been harder. Although predictions of recovery in America must of necessity be cautious, the general tone of reports seems a little better, and there is some reason to believe that the worst has been seen in industrial conditions.

Closing quotations :—

Cash.—Friday, £45 17s. 6d. to £46; Monday, £46 12s. 6d. to £46 13s. 9d.; Tuesday, £45 12s. 6d. to £45 18s. 9d.; Wednesday, £46 to £46 2s. 6d.

Three Months.—Friday, £45 15s. to £45 17s. 6d.; Monday, £46 8s. 9d. to £46 10s.; Tuesday, £45 11s. 3d. to £45 12s. 6d.; Wednesday, £45 15s. 3d. to £45 17s. 6d.

Tin.—However good the latest scheme for output restriction may appear in theory, its execution cannot fail to be difficult, and the hard fact remains that until consumption improves considerably the outlook for tin cannot be very bright. The world's largest consumer of tin—America—is not, unfortunately, showing any signs that her trade is better, and buyers there have not followed the last advance seriously. According to the statistics of Messrs. Ricard & Freiwald, the total visible supplies of tin at the end of December amounted to 42,140 tons, an increase of 1,741 tons over the end November total.

Official closing prices :—

Cash.—Friday, £116 10s. to £116 12s. 6d.; Monday, £119 7s. 6d. to £119 10s.; Tuesday, £118 10s. to £118 12s. 6d.; Wednesday, £119 to £119 5s.

Three Months.—Friday, £118 to £118 2s. 6d.; Monday, £120 17s. 6d. to £121; Tuesday, £119 17s. 6d. to £120; Wednesday, £120 10s. to £120 12s. 6d.

Spelter.—Interest in this market is very limited, and consumers seem to be adequately covered for their immediate needs. There is so far no sign of improvement in the position, nor can there be any until conditions in the galvanised-sheet trade become more active. Meanwhile the holiday and stocktaking stoppages at users' works have accentuated the dull conditions.

Daily fluctuations :—

Ordinary.—Friday, £13 6s. 3d.; Monday, £13 7s. 6d.; Tuesday, £13 7s. 6d.; Wednesday, £13 7s. 6d.

Lead.—Business with consumers remains very dull, and it is feared that the statistical position will deteriorate further during the present month. The apathy of consumers has resulted in considerable quantities of metal which arrived during December being placed in warehouse.

The week's prices have been :—

Soft Foreign (Prompt).—Friday, £14 5s.; Monday, £14 12s. 6d.; Tuesday, £14 7s. 6d.; Wednesday, £14 6s. 3d.

Students' Corner.

(*Continued from page 452, Vol. 43*).

Q.—What are we to understand by the terms, in-gates, down-gates and connected passage-gates?

A.—The in-gates are the direct passages into the moulds. Down-gates are the vertical passages from the pouring basin to the channel connecting the in-gates. Connecting passage-gates are situate between the down-gate and the in-gate.

Q.—Are there any precautions or rules to follow regarding pouring basins?

A.—A pouring basin is as important and needs the same care as any other part of the mould. Badly made pouring basins have been responsible for many wasters, this applying to both large and small castings. Large castings which have taken several weeks to mould have been wasters simply due to a faultily moulded runner basin. For large green-sand pouring basins the sand should be mixed thoroughly, tempered and riddled before using. The moisture in the sand should be no more, or less, than the moisture for ordinary green-sand moulding. It is not necessary to use facing sand at the same time for pouring basins which have to stand a long flow of metal; the sand should not be too strong, or too weak, that is new sand containing a large percentage of clay matter should be used sparingly; also, the sand must not be too weak or burnt. A good floor sand which is unspent, properly tempered, mixed and riddled generally meets the requirements for green-sand pouring basins.

The same precautions must be taken in regard to hardness as with ordinary moulding. Often wasters are the result of hard ramming on the bottom surface of the basin.

A liquid metal will not lie quietly on a hard surface, but will scab from the bottom of the basin, which will continue so long as the pouring continued. Where it is essential to have a large area of flat surface in a pouring basin, which should be avoided if possible, it is wise as a precaution so to arrange the basin box to make it convenient to pass a few vents underneath the box within a couple of inches of the surface of the basin. This may be done by inserting small ropes or short lengths of ¼-in. diameter rods, laid underneath the basin box, and before pouring, pulled out. This plan is often the cure. It prevents scabbing and blowing, and allows for a slight margin of error regarding strong or over moist sand, and hardness of surface, but venting is no help to sand that is burnt or too weak.

(*To be continued.*)

FOUNDRY BOXES

Sterling

...that speed up production for the Modern Foundry—

One of the greatest improvements you can introduce into your foundry is the STERLING ROLLED STEEL MOULDING BOX . . . . the result is speed and economy all round. Your moulders will put down more moulds per day because of the light and easy handling properties of these boxes.

You will be sure of producing accurate castings because STERLING BOXES maintain their accuracy permanently. Also your moulding costs will be halved—STERLING BOXES stand up to heavy service, anywhere.

UP-TO-DATE

MOULDING BOX EQUIPMENT

Save their cost in a few months, and are obviously a sound investment for any foundry.

STERLING FOUNDRY SPECIALTIES LTD.,

WORKS— BEDFORD.

LONDON OFFICE:— 13, VICTORIA STREET, S.W.1.

GLASGOW - MANCHESTER - NEWCASTLE-ON-TYNE.

XUM

WEEKLY PRICE CURRENT.

COPPER.

	£	s.	d.
Standard cash	46	0	0
Three months	45	15	3
Electrolytic	48	10	0
Tough	46	10	0
Best selected	47	0	0
Sheets	77	0	0
India	59	5	0
Wire bars	49	17	6
Do. March	49	17	6
Do. April	49	17	6
Ingot bars	49	17	6
H.C. wire rods	49	10	0
Off. av. cash, December	46	16	4 1/4
Do., 3 mths. December	46	13	7 1/16
Do., Sttlmnt., December	46	15	11 3/8
Do., Electro, December	50	14	5 1/2
Do., B.S., December	48	15	7 1/4
Do., wire bars, December	51	7	7 1/2
Solid drawn tubes			11 1/4d.
Brazed tubes			11 1/4d.
Wire			7 1/4d.

BRASS.

Solid drawn tubes	10d.
Brazed tubes	12d.
Rods, drawn	9 3/4d.
Rods, extd. or rlld.	5 7/8d.
Sheets to 10 w.g.	8 1/4d.
Wire	8 1/4d.
Rolled metal	7 3/4d.
Yellow metal rods	5 3/4d.
Do. 4 × 4 Squares	6 1/4d.
Do. 4 × 3 Sheets	6 1/4d.

TIN.

	£	s.	d.
Standard cash	119	0	0
Three months	120	10	0
English	120	10	0
Bars	121	12	6
Straits	122	15	0
Australian	120	0	0
Eastern	124	5	0
Banca	122	10	0
Off. av. cash, December	111	12	4 1/2
Do., 3 mths., December	112	17	10 1/2
Do., Sttlmt., December	111	12	4 1/2

SPELTER.

	£	s.	d.
Ordinary	13	7	6
Remelted	12	0	0
Hard	10	0	0
Electro 99.0	15	12	6
English	13	17	6
India	11	15	0
Zinc dust	20	0	0
Zinc ashes	3	5	0
Off. aver., December	13	19	9 1/2
Aver., spot, December	13	15	2 1/2

LEAD.

	£	s.	d.
Soft foreign ppt.	14	6	3
English	15	15	0
Off. average, December	15	5	8 13/16
Average spot, December	15	5	7 1/2

ZINC SHEETS, &c.

	£	s.	d.
Zinc sheets, English	22	0	0
Do. V.M. ex-whf.	24	0	0
Rods	26	0	0
Boiler plates	18	15	0
Battery plates	19	10	0

ANTIMONY.

	£	s.	d.
Special brand, Eng.	36	0	0
Chinese	25	5	0
Crude	22	0	0

QUICKSILVER.

	£	s.	d.
Quicksilver	22	7	6

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon—	
25%	£7 17 6
45/50%	£11 10 0
75%	£18 10 0
Ferro-vanadium—	
35/50%	12/8 lb. Va.
Ferro-molybdenum—	
70/75% c. free	4/2 lb. Mo.
Ferro-titanium—	
23/25% carbon-free	10d. lb.
Ferro-phosphorus, 20/25%	£15 17 6
Ferro-tungsten—	
80/85%	2/3 lb.
Tungsten metal powder—	
98/99%	2/6 lb.
Ferro-chrome—	
2/4% car.	£30 10 0
4/6% car.	£23 5 0
6/8% car.	£22 10 0
8/10% car.	£22 2 6
Ferro-chrome—	
Max. 2% car.	£32 17 6
Max. 1% car.	£37 15 0
Max. 0.70% car.	£41 0 0
70% carbon-free	10d. lb.
Nickel—99% cubes, or pellets	£170 0 0
Ferro-cobalt	9/6 lb.
Aluminium 98/99%	£85 0 0
Metallic chromium—	
96/98%	2/7 lb.
Ferro-manganese (net)—	
76/80% loose	£11 0 0 to £11 15 0
76/80% packed	£12 0 0 to £12 15 0
76/80% export	£11 0 0 to £11 10 0
Metallic manganese—	
94/96% carbonless	1/4 lb.

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten	£0 2 2
Finished bars, 18% tungsten	£0 3 0

Per lb. net, d/d buyers' works.

Extras—

Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under ½ in. to ¼ in.	3d. lb.
Do., under ¼ in. to 1/16 in.	1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ⅛ in.	3d. lb.
Do., under ½ in. × ¼ in.	1/- lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

SCRAP.

	£	s.	d.		£	s.	d.
South Wales—							
Heavy steel					2	5	0
Bundled steel and shrngs.	1	14	0	to	1	15	0
Mixed iron and steel	1	17	0	to	2	0	0
Heavy cast iron	2	7	6	to	2	9	0
Good machinery for foundries	2	7	6	to	2	10	0
Cleveland—							
Heavy steel					2	6	0
Steel turnings					1	15	0
Cast-iron borings					1	10	0
Heavy forge					3	2	6
W.I. piling scrap					2	18	6
Cast-iron scrap	2	10	0	to	2	12	6
Midlands—							
Light cast-iron scrap					2	5	0
Heavy wrought					3	0	0
Steel turnings						—	
Scotland—							
Heavy steel					2	7	6
Ordinary cast iron					2	11	3
Engineers' turnings					1	12	6
Cast-iron borings					1	15	0
Wrought-iron piling					2	18	6
Heavy machinery					2	15	0

London—Merchants' buying prices delivered yard.

Copper (clean)	38 0 0
Brass	28 0 0
Lead (less usual draft)	13 0 0
Tea lead	9 10 0
Zinc	7 0 0
New aluminium cuttings	50 0 0
Braziery copper	35 0 0
Gunmetal	37 0 0
Hollow pewter	76 0 0
Shaped black pewter	56 0 0

PIG-IRON.

(f.o.t. unless otherwise stated.)

N.E. Coast—	
Foundry No. 1	61/-
Foundry No. 3	58/6
Foundry No. 4	57/6
Forge No. 4	57/-
Hematite No. 1	70/6
Hematite M/Nos.	70/-
N.W. Coast—	
Hem. M/Nos. d/d Glas.	78/-
„ d/d Birm.	88/6
Midlands—	
Staffs. common*	—
„ No. 4 forge*	66/-
„ No. 3 fdry.*	71/-
Shrops. basic	—
„ Cold blast, ord.	—
„ „ roll iron	—
Northants forge*	62/6
„ fdry. No. 3*	67/6
Derbyshire forge*	66/-
„ fdry. No. 3*	71/-
„ basic*	—

*d/d Black Country dist.

Scotland—	
Foundry No. 1	79/-
„ No. 3	76/6
Hem. M/Nos.	76/-
Sheffield (d/d district)—	
Derby forge	61/-
„ fdry. No. 3	66/-
Lincs. forge	—
„ fdry. No. 3	66/-
E.C. hematite	82/6
W.C. hematite	86/6
Lincs. (at furnaces)—	
Forge No. 4	—
Foundry No. 3	—
Basic	—
Lancashire (d/d eq. Man.)—	
Derby forge	64/6
„ fdry. No. 3	69/6
Staffs foundry No. 3	69/6
Dalzell, No. 3 (special)	105/- to 107/6
Summerlee, No. 3	90/6 to 91/-
Glengarnock, No. 3	—
Eglinton, No. 3	90/6 to 91/-
Gartsherrie, No. 3	90/6 to 91/-
Monkland, No. 3	90/6 to 91/-
Shotts, No. 3	90/6 to 91/-

FINISHED IRON AND STEEL

Usual District deliveries for iron; delivered consumers' station for steel.

Iron—	£	s.	d.		£	s.	d.
Bars (cr.)	10	0	0	to	10	15	0
Nut and bolt iron	8	15	0	to	9	0	0
Hoops	10	15	0	to	12	0	0
Marked bars (Staffs) f.o.t.					12	10	0
Gas strip	10	15	0	to	12	0	0
Bolts and nuts, ½ in. × 4 in.					14	5	0
Steel—							
Ship plates	8	15	0	to	8	17	6
Boiler plts.	9	5	0	to	10	5	0
Chequer plts.					10	12	6
Angles					8	7	6
Tees					9	7	6
Joists					8	10	0
Rounds and squares, 3 in. to 5½ in.					9	7	6
Rounds under 3 in. to ½ in. (Untested)					7	12	6

and upwards

Flats—8 in. wide and over	8 12 6
„ under 8 in. and over 5in.	8 17 6
Rails, heavy	8 10 0
Fishplates	12 0 0
Hoops (Staffs)	9 5 0 to 9 10 0
Black sheets, 24g.	8 12 6 to 9 12 6
Galv.cor.shts., 24g.	11 5 0
Galv. fencing wire, 8g. plain	12 0 0
Billets, soft	5 12 6 & up.
Billets, hard	7 2 6 & up.
Sheet bars	5 0 0 to 5 12 6
Tin bars	5 0 0 to 5 12 6

PHOSPHOR BRONZE.

Per lb. basis.

Strip	1/0½
Sheet to 10 w.g.	1/0¾
Wire	1/1½
Rods	1/0¾
Tubes	1/5½
Castings	1/0½

Delivery 3 cwt. free.
10% phos. cop. £30 above B.S.
15% phos. cop. £35 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. CLIFFORD & SON, LIMITED.

NICKEL SILVER, &c.

per lb.

Ingots for raising	8d. to 1/2
Rolled—	
To 9 in. wide	1/2 to 1/8
To 12 in. wide	1/2½ to 1/8½
To 15 in. wide	1/2½ to 1/8½
To 18 in. wide	1/3 to 1/9
To 21 in. wide	1/3½ to 1/9½
To 25 in. wide	1/4 to 1/10
Ingots for spoons and forks	8d. to 1/4½
Ingots rolled to spoon size	11d. to 1/7½
Wire round—	
3/0 to 10 G.	1/5½ to 2/0½

with extras according to gauge.

AMERICAN IRON AND STEEL.

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	17.76
No. 2 foundry, Valley	17.00
No. 2 foundry, Birm.	14.00
Basic	18.76
Bessemer	19.26
Malleable	19.26
Grey forge	18.26
Ferro-mang. 80%	94.00
O.-h. rails, h'y, at mill	43.00
Billets	30.00
Sheet bars	30.00
Wire rods	36.00
	Cents.
Iron bars, Phila.	2.09
Steel bars	1.60
Tank plates	1.60
Beams, etc.	1.60
Skelp, grooved steel	1.60
Skelp, sheared steel	1.60
Steel hoops	1.90
Sheets, black, No. 24	2.35
Sheets, galv., No. 24	2.90
Sheets, blue an'l'd, No. 13	2.05
Wire nails	1.90
Plain wire	2.30
Barbed wire, galv.	2.55
Tinplates, 100-lb. box	$5.00

COKE (at ovens).

Welsh foundry	25/- to 27,6
„ furnace	16/- to 18/-
Durham and Northumberland—	
„ foundry	15/- to 15/6
„ furnace	14/6
Midlands, foundry	—
„ furnace	—

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. cokes	20×14 box	15/3 to 15/6
„	28×20 „	31/-
„	20×10 „	22/9
„	18¾×14 „	16/3
C.W.	20×14 „	15/-
„	28×20 „	29/6
„	20×10 „	21/-
„	18¾×14 „	16/-
Terneplates	28×20	31/- per box basis f.o.b.

SWEDISH CHARCOAL IRON & STEEL.

Pig-iron	£6	0	0	to	£7	10	0
Bars, hammered, basis	£17	10	0	to	£18	10	0
Bars and nail-rods, rolled, basis	£15	17	6	to	£16	15	0
Blooms	£10	0	0	to	£12	0	0
Keg steel	£32	0	0	to	£33	0	0
Faggot steel	£20	0	0	to	£24	0	0
Bars and rods dead soft, steel	£11	0	0	to	£14	0	0

All per English ton, f.o.b. Gothenburg.

TUBES AND FITTINGS.

Over ¼ in. up to 6 in.

	Tubes.	*Fittings.*
Gas	62½%	47½%
Water ..	58½%	42½%
Steam ..	55%	37½%

W.I. 12½% extra.

DAILY FLUCTUATIONS.

Standard Copper (cash).

		£	s.	d.	
Jan.	2 ..	45	17	6	dec. 11/3
,,	5 ..	46	12	6	inc. 15/–
,,	6 ..	45	12	6	dec. 20/–
,,	7 ..	46	0	0	inc. 7/6

Electrolytic Copper.

		£	s.	d.	
Jan.	2 ..	48	15	0	dec. 15/–
,,	5 ..	49	5	0	inc. 10/–
,,	6 ..	48	10	0	dec. 15/–
,,	7 ..	48	10	0	No change

Standard Tin (cash).

		£	s.	d.	
Jan.	2 ..	116	10	0	No change
,,	5 ..	119	7	6	inc. 57/6
,,	6 ..	118	10	0	dec. 17/6
,,	7 ..	119	0	0	inc. 10/–

Tin (English ingots).

		£	s.	d.	
Jan.	2 ..	117	12	6	dec. 7/6
,,	5 ..	120	10	0	inc. 57/6
,,	6 ..	119	12	6	dec. 17/6
,,	7 ..	120	10	0	inc. 17/6

Zinc Sheets (English).

		£	s.	d.	
Jan.	2 ..	22	0	0	No change
,,	5 ..	22	0	0	,, ,,
,,	6 ..	22	0	0	,, ,,
,,	7 ..	22	0	0	,, ,,

Spelter (ordinary).

		£	s.	d.	
Jan.	2 ..	13	6	3	dec. 8/9
,,	5 ..	13	7	6	inc. 1/3
,,	6 ..	13	7	6	No change
,,	7 ..	13	7	6	,, ,,

Lead (English).

		£	s.	d.	
Jan.	2 ..	15	15	0	dec. 10/–
,,	5 ..	16	0	0	inc. 5/–
,,	6 ..	16	0	0	No change
,,	7 ..	15	15	0	dec. 5/–

AVERAGE MONTHLY PRICES OF FURNACE COKE D/D MIDDLESBROUGH.

Year.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1895	0 12 3	0 12 3	0 12 3	0 12 3	0 12 3	0 12 3	0 12 3	0 12 3	0 12 6	0 13 3	0 13 3	0 13 3	0 12 5½
1896	0 13 0	0 13 0	0 13 6	0 13 6	0 13 6	0 13 9	0 13 6	0 13 3	0 13 3	0 13 3	0 13 6	0 13 6	0 13 4½
1897	0 13 6	0 13 6	0 13 6	0 13 3	0 13 3	0 13 6	0 13 6	0 13 6	0 13 3	0 13 3	0 13 0	0 13 6	0 13 4½
1898	0 13 6	0 13 6	0 15 0	0 13 6	0 13 9	0 14 0	0 14 3	0 14 3	0 14 6	0 14 9	0 15 0	0 15 6	0 14 3½
1899	0 15 6	0 15 6	0 16 0	0 16 3	1 0 0	1 1 0	1 1 6	1 1 6	1 1 6	1 1 0	1 2 0	1 5 0	0 19 8½
1900	1 5 0	1 5 6	1 6 6	1 8 0	1 8 6	1 9 0	1 9 0	1 8 0	1 8 0	1 7 0	1 3 0	0 19 0	1 6 4½
1901	0 17 6	0 14 0	0 13 0	0 14 0	0 14 6	0 15 0	0 15 3	0 15 3	0 15 9	0 16 6	0 16 9	0 16 9	0 16 4½
1902	0 16 9	0 15 0	0 15 0	0 15 0	0 15 0	0 15 3	0 15 3	0 15 3	0 15 6	0 16 0	0 16 6	0 16 0	0 15 5
1903	0 15 9	0 16 0	0 16 3	0 16 9	0 16 6	0 16 3	0 16 0	0 15 9	0 15 6	0 15 0	0 14 6	0 14 0	0 15 8½
1904	0 13 9	0 13 9	0 13 3	0 14 3	0 14 6	0 14 3	0 14 3	0 14 3	0 14 3	0 14 0	0 14 0	0 14 6	0 14 1½
1905	0 14 9	0 15 3	0 15 3	0 15 3	0 15 6	0 15 6	0 15 6	0 15 6	0 15 6	0 15 6	0 15 9	0 17 0	0 15 5½
1906	0 17 6	0 17 6	0 17 0	0 17 0	0 17 0	0 16 6	0 17 0	0 17 0	0 18 3	0 18 6	0 19 0	1 0 0	0 17 8½
1907	1 4 6	1 5 0	1 5 0	1 0 6	1 2 0	1 1 0	1 1 0	1 1 0	1 2 0	1 1 6	1 0 0	0 17 0	1 1 8½
1908	0 16 0	0 16 0	0 15 6	0 16 0	0 16 3	0 16 0	0 15 6	0 15 6	0 15 6	0 15 3	0 16 6	0 16 0	0 15 9½
1909	0 16 0	0 15 3	0 15 0	0 14 9	0 15 6	0 15 9	0 15 6	0 15 6	0 16 6	0 17 0	0 17 6	0 17 0	0 15 11½
1910	0 18 4½	0 18 6½	0 18 0	0 18 0	0 17 10½	0 17 0	0 16 1½	0 15 9½	0 15 11	0 16 0	0 15 9½	0 15 8	0 16 11
1911	0 16 0	0 15 10½	0 15 6	0 15 3	0 14 9	0 14 6	0 14 6	0 14 6	0 14 6	0 14 11½	0 15 0½	0 16 3½	0 15 1½
1912	0 17 3	0 17 3	0 18 6	0 18 10	0 19 0	0 19 4½	0 19 10½	1 0 9½	1 2 9	1 4 1½	1 5 8½	1 8 6	1 1 0
1913	1 5 9	1 4 11	1 5 0	1 5 0	1 4 9½	1 0 4½	0 19 5½	0 18 3	0 18 0	0 18 2½	0 18 6	0 18 6	1 1 4½
1914	0 18 2	0 17 1	0 17 0	0 17 0	0 17 4	0 17 6	0 17 6	0 18 5	0 18 4	0 17 9	0 17 6	0 18 5	0 17 8
1915	0 17 10½	0 17 9	1 0 4½	1 7 7½	1 9 4½	1 10 7½	1 9 7	1 7 3	1 5 4	1 4 9	1 9 6	1 13 0	1 6 1
1916	1 10 9	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6½
1917	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 14 3	1 15 6	1 11 2½
1918	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6
1919	1 15 6	1 15 6	1 15 6	1 15 6	2 1 6	2 1 6	2 3 9	2 10 6	2 10 6	2 10 6	2 10 6	2 10 6	2 3 5
1920	2 12 3	2 14 0	2 19 0	2 19 0	3 3 8	3 6 0	3 6 0	3 6 0	3 6 0	3 6 0	3 6 0	3 6 0	3 2 6
1921	3 1 0½	2 19 0	2 16 0	2 7 0	2 6 6	2 6 6	2 0 6	2 0 0	1 13 11	1 12 9	1 10 4½	1 8 3	2 3 6½
1922	1 7 0½	1 8 1½	1 9 7½	1 8 4½	1 7 11½	1 7 3	1 6 9½	1 6 10½	1 7 0½	1 10 2½	1 10 0	1 9 11½	1 8 3½
1923	1 11 3	1 14 6	2 0 1½	2 2 8½	2 4 4½	2 2 10½	2 1 0½	2 1 6	2 0 9½	1 18 9	1 18 8½	1 18 3	1 19 7½
1924	1 16 6½	1 14 9	1 11 11½	1 10 0½	1 8 1½	1 7 8½	1 7 3	1 6 3	1 6 0	1 5 0	1 5 0	1 5 0	1 9 5½
1925	1 4 10½	1 4 1½	1 13 3	1 2 4½	1 2 2½	1 1 5½	1 1 3½	1 4 9	0 18 10½	0 18 4½	0 19 6½	1 1 4½	1 2 8½
													(5 months)
1926	1 2 1½	1 0 9	0 19 2½	0 18 6½	Strike	Strike	Strike	Strike	Strike	Strike	Strike	1 5 0	1 1 1½
1927	1 5 6	1 4 9½	1 6 1½	1 3 9	1 2 6	1 0 8½	0 19 4½	0 19 0	0 18 7½	0 18 0	0 17 10½	0 17 6	1 1 1½
1928	0 17 6	0 17 10½	0 18 0½	0 17 11½	0 17 8½	0 17 6½	0 17 7½	0 17 6½	0 17 6	0 17 7½	0 17 7½	0 17 6	0 17 11
1929	0 17 7½	0 18 0	0 19 0	0 19 6½	0 18 10½	0 19 10½	1 1 3½	1 1 8½	1 3 0	1 3 6	1 3 8	1 3 1½	1 0 9½
1930	1 2 6½	1 1 3	1 0 3	0 19 1½	0 17 7	0 16 10½	0 16 6	0 16 6	0 16 9	0 17 0	0 17 0	0 17 0	0 18 2½

WILLIAM JACKS & COMPANY,

WINCHESTER HOUSE, OLD BROAD ST., LONDON, E.C.2.

18, BENNETTS HILL, BIRMINGHAM.

PIG IRON

REGISTERED TRADE MARK

All grades FOUNDRY, HEMATITE, BASIC, SPECIALS, &c.

NON-FERROUS METALS

COPPER, TIN, LEAD, SPELTER, ANTIMONY, CHROME ORE.

WILLIAM JACKS & COMPANY,

19, ST. VINCENT PLACE, GLASGOW.

ZETLAND ROAD, MIDDLESBROUGH.

SMALL ADVERTISEMENTS.

Notice.

Small Advertisements in this section of the Journal are accepted at the prepaid rate of 6d. per line, first line in capitals counting two, average 6 words per line. Minimum charge for one insertion 3/-

(A remittance should accompany instructions.)

SITUATIONS VACANT AND WANTED.

FOUNDRY Manager at liberty, with practical and commercial experience; I.B.F., F.M.B. member. All classes of work; rate-fixing. Good, sound references.—Box 700, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

FOUNDRY Foreman required for large foundry making light castings; knowledge of moulding machines essential.—Full particulars and salary required, Box 698, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

PATENTS AND TRADE MARKS.

PROTECT YOUR IDEAS.—Free, Advice and Handbook on patenting inventions and registering trade marks by Registered Agent with 43 years' experience.—KING'S PATENT AGENCY, LIMITED, 146A, Queen Victoria Street, E.C.4.

MACHINERY.

WANTED, battery of four 90-lb. Pot Coke-fired Brass Furnaces.—FLAVELS, Eagle Foundry, Leamington.

FOR Disposal, 3-ton Travelling Hand Crane, span 28 ft. Any offers.—FLAVELS, Eagle Foundry, Leamington.

SAND MIXERS.—New and Secondhand. Ask us to quote.—W. BREALEY & COMPANY, LIMITED, Station Works, Ecclesfield, Sheffield.

FOR Sale, entire Working Plant of an Iron Foundry, including 3-ton Travelling Crane, etc.—Particulars from COYSH & SMITH, 49, Monmouth Road, Portsmouth.

THOS. W. WARD, LTD.

Pneumatic Sand Moulding Machine, admit pattern boxes 16 in. x 16 in. x 6 in.

"EVER-READY" Electric Table Surface Grinder, 14-in. and 20-in. dia. stones.

"EVER-READY" Electric Finisher; floor type, size 30 in. x 8 in.

CINCINNATI 12-in. x 48-in. Universal Grinder.

4-ton PORTABLE HAND CRANE (Rushworth), 17-ft. 0-in. steel derricking jib; 4-ft. 8½-in. gauge.

15-ton STEAM DERRICK CRANE (Anderson), 65-ft. 0-in. jib; 80 lbs. w.p.

LANCASHIRE BOILER, 30 ft. 0 in. x 8 ft. 6 in., re-insure 150 lbs. pressure.

Good Secondhand BABCOCK & WILCOX WATER-TUBE BOILER, of 4,356 ft. of heating surface, re-insurable at a working pressure of 150 lbs. per sq. in., with chain-grate stoker, etc.

COCHRAN BOILER, 11 ft. 3 in. x 5 ft. 0 in., working steam pressure 150 lbs. per sq. in.

FOUNDRY LADLES, various types and sizes.

PRESSURE RECEIVERS, 24 ft. 0 in. x 4 ft. 6 in., hydraulically tested to 300 lbs. per sq. in.

(ASK FOR "ALBION" MACHINERY CATALOGUE.)

ALBION WORKS, SHEFFIELD.

TENDER.

ARMY CONTRACTS.

NOTICE is hereby given that Tenders for quantities of the undermentioned manufactured goods are invited from time to time, as required:—

METAL TRADES.

Aluminium ingot, Brass, Brass rod and sheet, Bronze stampings, Copper ingot and sheet, Lead, pig and sheet, Metal rod, Nickel, Pig-iron, Steel plate, rounds, sheets, etc., Shell steel, Tin ingot, Tinplates, Zinc ingot and sheets.

Baths, Bicycles, Building materials and fitments, Cutlery (including safety razors and blades), Enamelled ware, Hollow-ware, Horseshoes, Ironmongery, Machinery, Pipes, steel and cast iron, Stable fitments, Stoves and ovens, Tinware, Tools, Vehicles, Wire, Wire Rope.

ELECTRICAL AND SCIENTIFIC INSTRUMENT TRADES.

Cables, Electrical plant, Electrical and wireless stores, Scientific instruments.

TEXTILE TRADES.

Blankets and rugs, Braid and lace, Canvas and canvas goods, Clothing (made up from Department's own materials), Cotton piece goods and cotton goods, Cordage, Flannel (Union), Headdresses, Horse rugs, Hosiery, Linen piece goods, Silk cloth and webbing and sewing silk, Towels, Woollen cloths.

FOODSTUFFS, COAL AND COKE.

OTHER TRADES.

Badges and buttons, Basket-ware, Bedding, Boots and shoes, Brooms and brushes, Chemicals and gases, China and earthenware, Furniture, Glazed ware drain pipes, Harness and saddlery, Leather and leather goods, Linoleum, Medical supplies, Oils and spirits, Paints and varnishes, Rubber boots and clothing, Sanitary appliances, Timber, Woodware.

Manufacturers who are not already on the War Office List of Tenderers, and who may wish to be invited to tender for Army requirements of the above stores, should apply to the Director of Army Contracts at the address given below for Form 1, on which formal application for inclusion on the list of tenderers may be made. The services of an intermediary are unnecessary in approaching the Department for this purpose.

Before being placed on the lists of tenderers, firms will have to satisfy the Department that they actually manufacture goods for which they wish to be noted, and will be required to furnish the names of at least two well-known firms or public bodies who have purchased from them and are in a position to certify as to the quality of their productions. They will further have to give an undertaking that they will comply with the Fair Wages Resolution of the House of Commons.

Attention is called to the following resolution passed by both Houses of Parliament on February 16, 1926:—

"That, in the opinion of this House, it is the duty of the Government in all Government contracts to make provision for the employment to the fullest possible extent of disabled ex-Service men, and to this end to confine such contracts, save in exceptional circumstances, to employers enrolled on the King's National Roll."

SALES.

From time to time the Department has for sale surplus Army stores of various descriptions, among which may be mentioned Machinery, Scrap Metals, Hutting, Motor Vehicles and spare parts, Medical and Dental Stores, Veterinary Stores, Optical and Scientific instruments, Electrical and Wireless stores, Clothing, Boots, Textile goods.

Firms who wish to be invited to tender for the purchase of surplus stores should apply as directed below.

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